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DEVELOPMENT AND CONSTRUCTION OF A WHEELCHAIR LIFT FOR A PREVOST LE MIRAGE INTERCITY COACH

Prepared for

TRANSPORTATION DEVELOPMENT CENTRE

Policy and Coordination Group

Transport Canada

Prepared By

Prévost Car Incorporated

and

T E S Limited

November 1990

PREVOST

The content of this report reflects the views of Prévost Car Inc. and T E S Limited and not necessarily the official view or opinions of the Transportation Development Centre of Transport Canada.

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This report describes the details of a new generation wheelchair lift, integrated into a Prévost Le Mirage Intercity Coach. The design presented introduces a simplified system for transporting disabled and elderly persons. The main objective of the project was to allow Prévost Car Inc. to gain the necessary expertise to produce an intercity coach with an integral wheelchair lift on their production line.

The modified coach is currently on demonstration. Some improvements were made to the lift doors to improve operational aspects. Overall, the project proved to be very successful from a technical aspect, providing many design benefits over the previous generations of coach lift systems.

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Projet de développement d'un élévateur dans le cadre du programme du transport des personnes handicapées (PTPH)

16. Résumé

Description détaillée d'une nouvelle plate-forme élévatrice intégrée pour l'autocar adapté Prévost Mirage XL, maintenant en service expérimental. Il s'agit d'une version simplifiée de plate-forme d'embarquement des passagers âgés ou handicapés. L'objectif principal de ce programme de recherche était de permettre à Prévost Car Inc. d'acquérir la technologie nécessaire pour construire un autocar à dispositif élévateur embarqué, dans le cadre de sa chaîne de production courante.

Les portes de la plate-forme ont été modifiées et leur fonctionnement amélioré, la nouvelle version s'avérant plus efficace et présentant de nombreux avantages techniques par rapport aux versions antérieures.

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SUMMARY

During 1987 and the spring of 1988, Prévost Car Inc. was contracted by the Transportation Development Centre of Transport Canada to develop and construct a prototype of a third generation wheelchair lift equipped coach. During this period, T E S Limited was subcontracted to design and construct the lift system. This project stemmed from the increasing need of various coach lines to accommodate wheelchair passengers.

The lift design was developed through a process guided by a Steering Committee, with representatives from coach lines, handicapped groups, Prévost Car Inc., and T E S Limited, and chaired by Transportation Development Centre.

One of the primary objectives of the program was to allow Prévost Car Inc. to gain the technology necessary to produce a coach with a wheelchair lift within their current production process. The coach used for this program - a Prévost Mirage XL, with a 47-passenger seating arrangement - was provided by Prévost Car Inc.

The design of the lift system incorporates a chain drive, which enables the use of a lighter platform, and minimizes both baggage space and passenger space consumption. A vertical run of chain is located at each of the four corners of the lift. The four chains are synchronized and driven from a hydraulic motor, upwards and downwards, which permits a very stable and controllable ascent and descent of the platform.

Reinforcements were added to the structure in the wall over the door opening, and around the lift opening in the main floor and baggage floor. These reinforcements incorporated the vertical guides for the lift mechanism. The baggage floor below the lift was lowered by 4 inches (100 mm) to maximize the headroom and minimize the ramp angle. This, in combination with the kneeling feature of the coach suspension, allows for an acceptable ramp angle under a variety of curbside conditions.

Accommodation has been provided for two forward facing wheelchairs, one on each side of the bus. The passenger seats have been designed such that, in the areas designated for wheelchair passengers, they fold and slide along rails to provide the wheelchair occupancy space. When the wheelchair space is not required, the passenger seats are positioned in a normal spacing, and no passenger occupancy is lost.

The original design of the lift doors was of a configuration which allowed the doors to open in a clam shell fashion where the lower door acted as the entrance ramp, or in a parallelogram fashion, similar to the other baggage doors. Some problems existed with this design and the doors were later modified to eliminate the parallelogram arrangement.

Another modification conducted on the lift doors was the change to an air over hydraulic actuation for the door opening and closure. The original pneumatic system produced an erratic movement which was viewed as a safety hazard.

The design of the third generation lift system proved to be very successful in its operation. Some benefits over previous designs include:

- A fixed baggage floor which results in greater structural integrity and maximum sealing within the baggage compartment.
- The lift is located adjacent to the front door, being more convenient for the operator and passenger.
- The clamshell style doors act as the lift doors as well as a canopy and an entrance ramp.
- The lift mechanisms and controls are simple, reliable and use existing industry technology which is easily understood by both drivers and maintenance personnel.

SOMMAIRE

Durant la période 1987-printemps 1988, la société Prévost Car Inc. a mis au point et construit pour le Centre de développement des transports de Transports Canada un troisième modèle d'autocar équipé d'un dispositif élévateur embarqué pour fauteuil roulant. La conception et la construction de la plate-forme élévatrice ont été confiées en sous-traitance à la société T E S Limited. Le projet avait été lancé en réponse à la demande croissante de services adaptés aux besoins des voyageurs à mobilité réduite.

Les études du dispositif élévateur ont été effectuées sous la direction d'un comité composé de représentants de compagnies de transport par autocars, de groupes de handicapés, de la Prévost Car Inc. et de la T E S Limited, et présidé par le CDT.

Un des principaux objectifs du programme était de permettre à Prévost Car Inc. d'acquérir la technologie nécessaire pour construire un autocar à dispositif élévateur embarqué dans le cadre de sa chaîne de production courante. Le véhicule utilisé aux fins du programme était un Mirage XL, 47 places, construit par ce fabriquant.

Le dispositif élévateur issu de ces travaux est actionné par chaînes, ce qui permet d'utiliser une plate-forme plus légère et réduit l'espace bagages et sièges emprunté. Les quatre coins de la plate-forme sont rattachés chacun à une chaîne de levage. Celles-ci sont entraînées par un moteur hydraulique et leur mouvement dans les deux sens est synchronisé, de sorte que la montée et la descente s'effectuent en douceur et à une vitesse réglable.

Des éléments d'armature ont été rajoutés dans la paroi du véhicule, au-dessus de la porte du dispositif élévateur, ainsi que dans le plancher principal et dans celui de la soute à bagages, autour de la cage du dispositif. Ces éléments d'armature servent aussi de guides verticaux pour le mécanisme élévateur. Le plancher sous la plate-forme élévatrice a été surbaissé de 4 pouces (100 mm) pour gagner de l'espace en hauteur et réduire la pente de la rampe d'accès. Grâce à cette disposition et à la suspension "baraquable" du véhicule, on obtient un angle d'inclinaison de la rampe d'accès acceptable dans diverses situations.

L'espace nécessaire a été aménagé pour deux fauteuils roulants faisant face à la marche, un de chaque côté du véhicule. Des sièges pliants et escamotables coulissant sur des rails ont été posés à cet endroit, de sorte qu'en l'absence de fauteuils roulants, les places peuvent être occupées par d'autres voyageurs.

Dans le premier modèle, les portes de la plate-forme élévatrice pouvaient s'ouvrir soit à la manière d'une coquille, la partie inférieure servant alors de rampe d'accès, soit de la manière classique des portes de la soute à bagages. Cette configuration présentait toutefois quelques problèmes et elle a été modifiée pour ne retenir que l'ouverture de type coquille.

Autre modification : le dispositif de commande pneumatique d'ouverture et de fermeture des portes, considéré comme dangereux parce qu'il fonctionnait par à-coups, a été remplacé par un dispositif hydraulique.

Cette troisième version de la plate-forme élévatrice s'est avérée très efficace. Elle présente plusieurs avantages par rapport aux versions antérieures, et notamment :

- Le plancher de la soute à bagages est fixe, d'où une plus grande intégrité structurale et une meilleure étanchéité de la soute.

- La plate-forme élévatrice est située juste à côté de la portière du véhicule, ce qui est plus commode pour le conducteur comme pour le voyageur.

- Les portes coquille remplissent en position ouverte une deuxième fonction : elles servent l'une de rampe d'accès et l'autre de protection contre les intempéries.

- Le mécanisme élévateur et les commandes sont simples, fiables et tirés d'une technologie existante facile à comprendre aussi bien pour les conducteurs que pour le personnel d'entretien.

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1.0 INTRODUCTION

In January 1985 the first wheelchair accessible intercity bus service in North America was inaugurated in St. John's, Newfoundland, using a first generation elevator lift developed and constructed by T E S Limited.

The success of this project, as well as the interest shown by coach operators and manufacturers, led to the development of a second generation lift incorporating significant improvements in the areas of passenger and baggage space utilization as well as aesthetics and ease of production. This coach was completed in 1986 and has been demonstrated across Canada and placed in service by various coach lines.

As the commercial possibilities of the wheelchair lift equipped coach had been demonstrated with these programs, Prévost Car Inc., a Quebec-based coach manufacturer, expressed interest in acquiring the specialized expertise necessary to introduce a wheelchair lift equipped coach into the marketplace. A contract was let by the Transportation Development Centre of Transport Canada to develop and construct a prototype of a third generation wheelchair lift equipped coach, with Prévost Car Inc. as the prime contractor, and T E S Limited as the subcontractor with responsibility for the design and construction of the lift system.

This report describes the design development and construction of the lift system and its associated features.

2.0 DESIGN DEVELOPMENT

The development process on this program was guided by a Steering Committee, with representation from coach lines, handicapped groups, Prévost Car Inc., and T E S Limited, and chaired by the Transportation Development Centre Project Officer. All aspects of the design and operation were reviewed by the Steering Committee and any suggestions for improvements were taken into account in the formulation of the final design. Detailed information on all components of the lift is contained in Appendix "A" (Operator's Manual), Appendix "B" (Maintenance Manual) and Appendix "C" (List of Engineering Drawings).

2.1 Subject Vehicle

The coach used for the installation of the lift was provided by Prévost Car Inc. The particular model used was a Prévost Mirage XL, with a 47-passenger seating arrangement.

The Mirage XL is a rear-engine three axle coach constructed using a space frame incorporating subframes for the front and rear suspensions and engine-transmission assembly. The exterior surface is composed of stressed skin of aluminum and stainless steel .

2.2 General Concepts

In the preliminary design stage, the following inter-related parameters were considered: lift location, structural modifications and lift mechanism. The optimum configuration was determined to be a lift located in the forward baggage compartment with a fixed baggage floor of a drop floor design. The drop floor design, in combination with the kneeling feature of the bus suspension system, allows for an acceptable entry ramp angle under a variety of curbside conditions. Although this arrangement reduces the entry headroom, advantages include a simplified lift mechanism and lighter structural reinforcements compared to the mechanism and structure required with a lift that lowered to the ground level. The forward lift location places the driver close to the wheelchair passengers for ease of operation and communications.

Chain drives were selected to operate the lift platform. Also considered was a system of levers. However, the chain drive enabled the use of a lighter platform and structure as cantilever loads were minimized. As well, the chain mechanism could be packaged efficiently with little lost space in the adjacent baggage compartments and almost no protrusion into the passenger compartment.

2.3 Structural Modifications

The system of structural reinforcements has a significant effect on the safety, weight and cost of the finished lift system. For these reasons, a theoretical finite element analysis and a strain gauge analysis were performed on the modified structure to ensure that the structural integrity of the coach was maintained with minimal extra weight.

Reinforcements were added to the structure in the wall over the door opening, and around the lift opening in the main floor and baggage floor. These reinforcements incorporated the vertical guides for the lift mechanism.

The baggage floor below the lift was lowered by 4 inches (100 mm) to maximize door headroom and minimize entrance ramp angle without affecting ramp clearance angles of the vehicle.

2.4 Lift Mechanism

Figure 1 illustrates the arrangement of the principal components of the lift mechanism.

In the design of the lift mechanism, space utilization, simplicity and safety were the governing factors. A vertical run of chain at each corner of the lift opening, with the chain driven upwards and downwards, permitted a controlled rate of ascent and descent. As well, in the event of chain failure, the platform would remain horizontal, secured by the remaining chains. The chains are wrapped around sprockets at the passenger floor and baggage floor. Transverse drive shafts, in front of and behind the lift well, drive the sprockets at the baggage floor level. A hydraulic motor provides power, through a reduction gearbox and a splitter gearbox, to output shafts that drive longitudinal chains connected to the transverse drive shafts. The hydraulic motor gearbox assembly is located immediately beside the lift well in the adjacent baggage compartment. The relative positions of the vertical drive chains are adjusted with synchronizer hubs on the drive shafts. Manually adjustable tensioners are provided on each chain drive. Each vertical chain assembly is housed in a U-shaped enclosure that also serves as a structural member.

The lift platform is a steel weldment covered by a plywood floor. Rubber seals around the edges of the platform prevent drafts from entering into the vehicle when the lift is in the raised position. The lugs attaching the drive chains to the platform are bolted into recesses in the platform. Movement of the platform is limited by contact between the lugs and the U-shaped guide enclosures.

An engine-driven hydraulic pump provides pressure to the drive motor through a directional control valve and a pressure relief valve, which limits the torque developed by the motor to prevent overloading of the mechanism. A manual pump enables the platform to be moved in the event of main pump failure.

In the fully raised position, the platform is held by two locks, one at the front and one at the rear of the platform. These locks consist of tapered pins extending through the lift well into recesses in the underside of the platform and are driven by double acting air cylinders through toggle linkages. The linkages prevent movement of the locks in the event of loss of air pressure.

2.5 Control System

The control system was designed for safe and reliable operation of the lift system. As usage of the system by the operators is expected to be infrequent, simplicity of operation was essential.

The operator has three controls available: the lift master switch, the platform switch, and the ramp operating switch. The lift master switch, located at the driver's console, activates the other controls. The platform switch, behind the lift area, lowers and raises the lift platform, and the ramp switch raises and lowers the ramp. The platform locks extend and retract automatically, depending on the position and direction of movement of the platform. Microswitches sense the position of the platform, platform locks and lift ramp, and, using relays, this information interlocks the controls to improve the safety and ease of operation of the lift system.

Telltale lamps at the driver's dash inform the driver of any unsafe condition that may exist while the bus is in operation, for example, if the lift ramp was unlocked.

2.6 Interior

Accommodation is provided for two wheelchairs on and beside the lift, with both wheelchairs facing forward. Access to the lift platform is controlled via barricade belts on the aisle side of the lift platform. These belts are stored in automatic retraction reels underneath the seat in front of the lift and extended manually into sockets in the seats behind the lift.

Interior luggage racks over the lift are removed to provide additional headroom above the lift.

A general arrangement of the interior at the lift is shown in Figure 2.

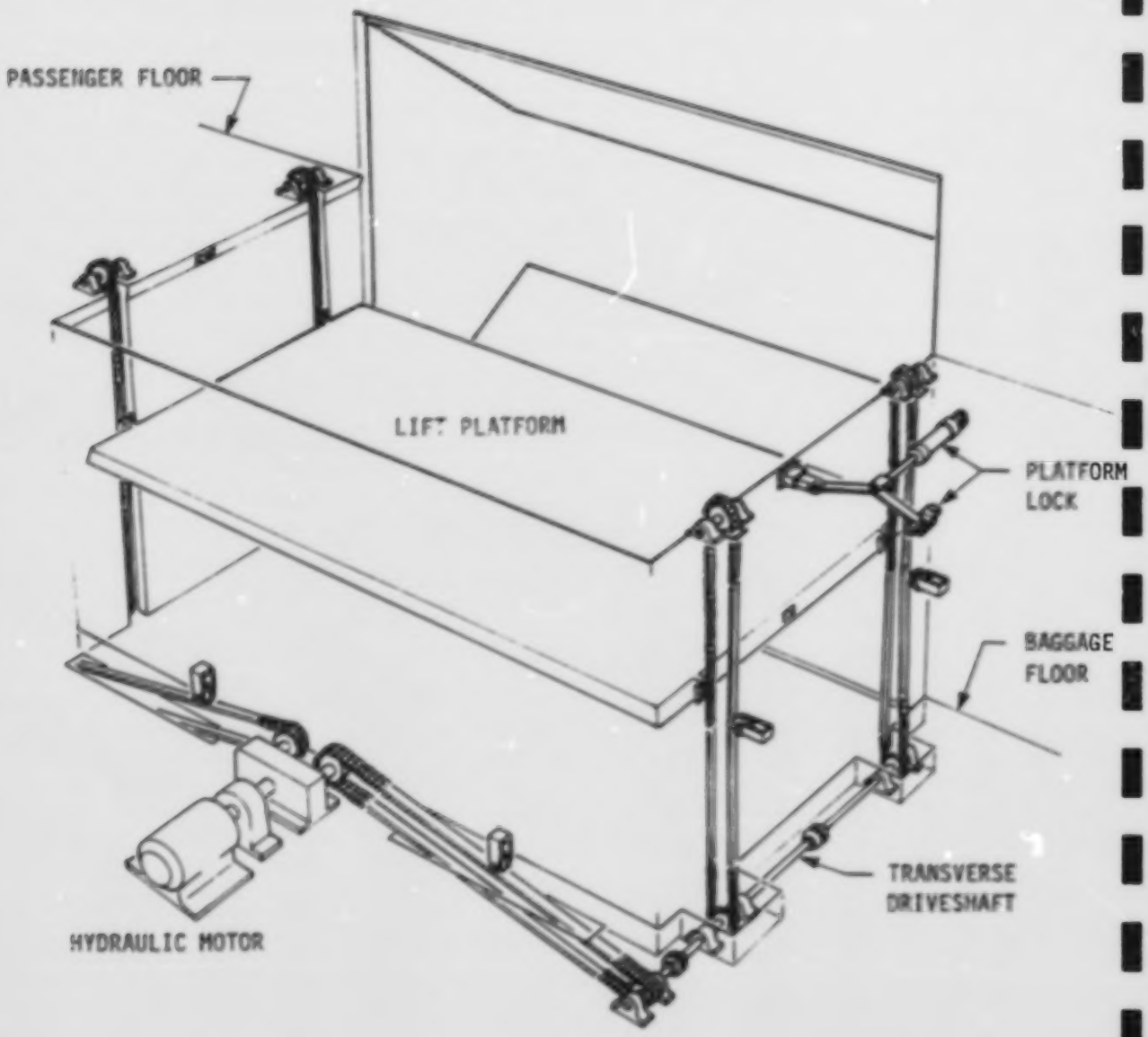

FIGURE 1

General Arrangement of Drive Mechanism

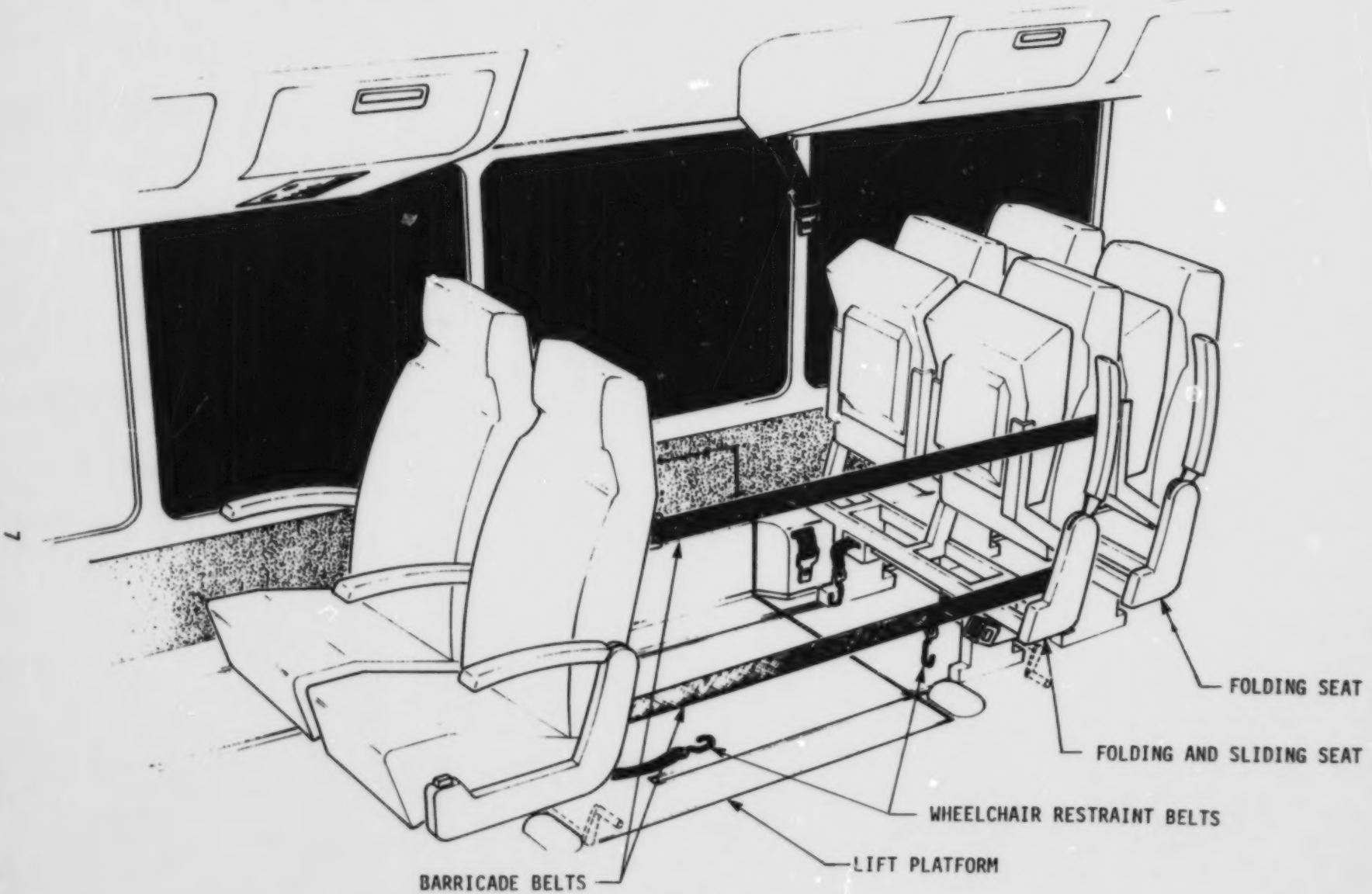

FIGURE 2

Interior Arrangement at Lift

2.7 Restraints and Seats

One of the improvements offered in the second generation lift was the arrangement of seats to provide for zero seat loss when wheelchair passengers were not accommodated. This feature was continued in the current design, with improvements in the wheelchair restraints.

Each of the two wheelchair positions utilizes a folding seat, a folding and sliding seat, and a wheelchair and occupant restraint system. These seats are modified versions of existing coach seats and offer equivalent comfort and appearance to the unmodified seats. When a wheelchair is to be transported, the bases of both the folding seat and the folding and sliding seat are pivoted upwards and the folding and sliding seat is moved rearward, against the folding seat. This sliding movement occurs along rails recessed into the floor and the seat is locked in position with manually operated latches.

The wheelchair restraints are designed to fit a variety of sizes and types of wheelchairs using belts and hooks that attach to the front and rear of the wheelchair. The belts extend from automatic retractors, with manual locking of the retraction mechanism.

Figure 3 illustrates the wheelchair and occupant restraint systems deployed at the left side of the coach.

2.8 Doors

The lift doors on this coach serve a dual function, acting as an entrance ramp for lift access as well as conventional baggage door when the lift is not in use. They are of a two-part design, hinged horizontally above and below the opening. The upper door also serves as a canopy.

The lower door has latches at the upper corners and combination latch/hinges at the lower corners. When the door is lowered as a ramp, only the upper latches are released and air cylinders raise and lower the door. When raised as a baggage door, the door is guided by a parallelogram linkage and assisted with a pair of gas filled struts. The air cylinders form a part of this linkage, and when the door is opened, the cylinders are pressurized to prevent unwanted cylinder extension.

The upper door is held in the closed position by an overhang on the lower door and is opened manually, with assistance from gas filled struts.

The upper door is of steel framed construction, with aluminum and stainless steel skins. The lower door has an aluminum frame to minimize its weight when used as a manually operated baggage door.

The two functions of the lift doors are illustrated in Figures 4 and 5.

FIGURE 3

Wheelchair Restraints on Left Side of Coach

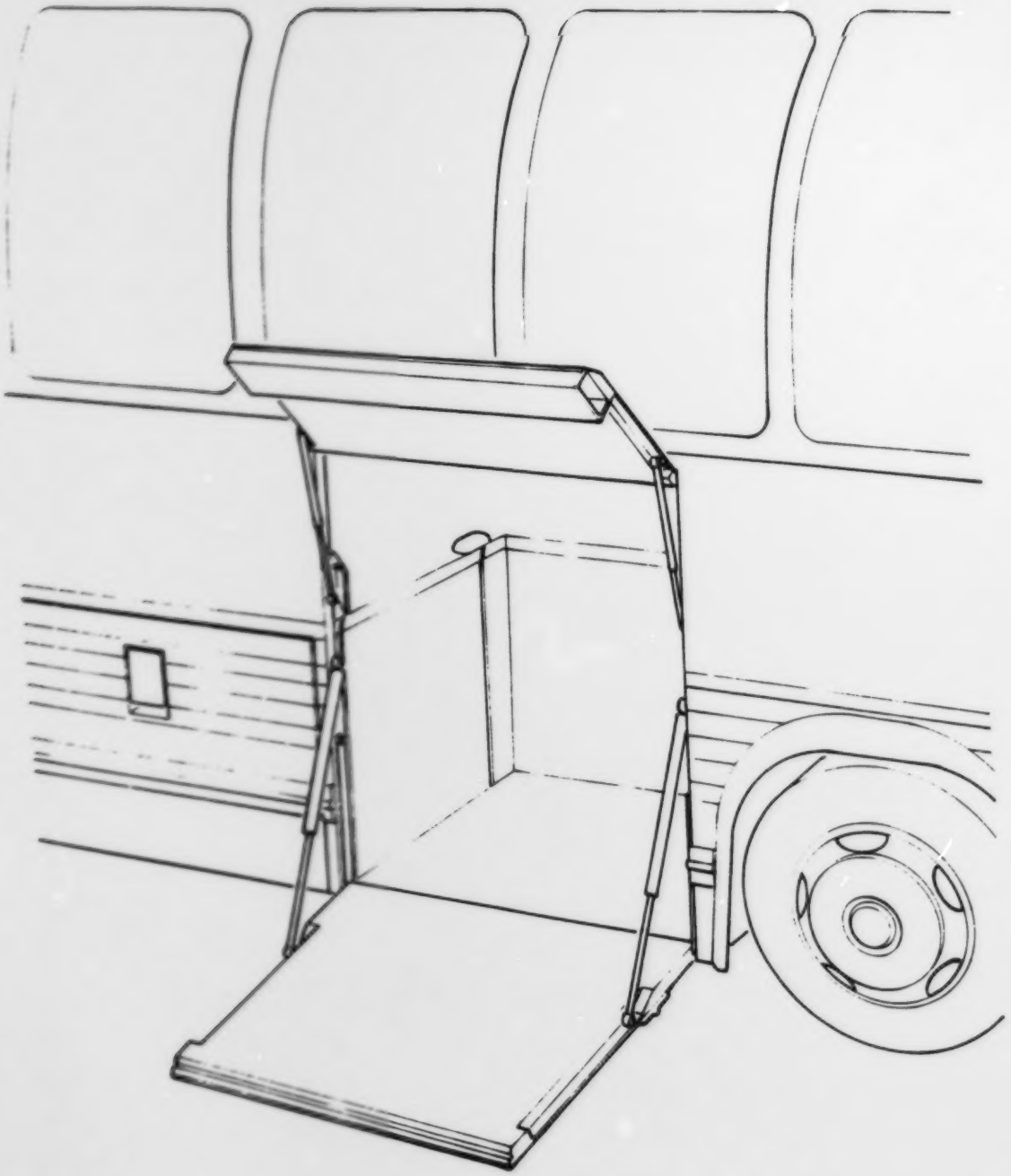

FIGURE 4

Lift Doors as Entrance Ramp

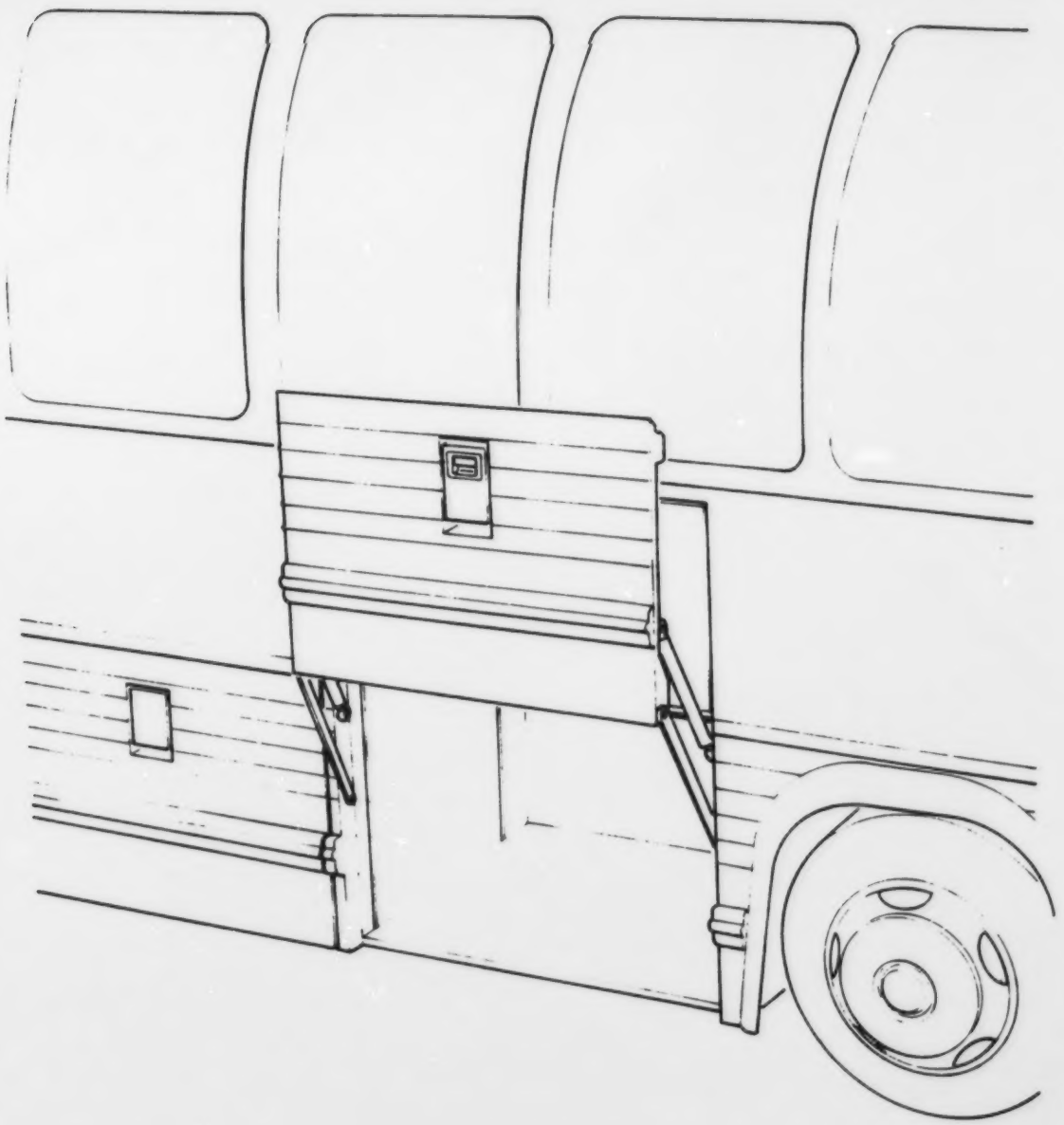

FIGURE 5

Lift Doors as Baggage Door

3.0 CONSTRUCTION

The frame of the Prévost Mirage coach selected for modification was fabricated on the Prévost production line, with the structural modifications being incorporated at this time. The completed coach, less interior fittings, seats, lift and lift door, was shipped to T E S Limited in October 1987, for installation of the lift mechanism, control system, seats and restraints. The completed lift system was then cycle tested and returned to Prévost Car Inc. in February 1988, where the lift door system was installed and interior trimming was completed. A copy of the cycling test report is provided in Appendix "D". A confirmation of the original structure analysis was performed using strain gauges on the structural members.

The methodology of construction allowed Prévost Car Inc. to gain experience in production techniques for the modified frame as well as observe the installation of the lift mechanism at T E S Limited.

The coach is currently on demonstration and has been on several tours including trips to the United States and New Brunswick. Through the demonstration program the lift has proved to be a technical success and has operated reliably and efficiently.

Many groups have expressed a great interest in the modified coach. However, the current market has not yet provided an actual demand for the product. The greatest potential comes from the United States where legislation is underway which will require that all new vehicle fleets contain a certain percentage of vehicles tailored for transporting the handicapped.

3.1 Prévost Modifications to Original Design

Once the coach was completed, the functionality of the lift system was reviewed as well as its operation. As in any prototype design, some problem areas were present and modifications were required. These modifications had a minor impact on the information contained in some sections of the operator's and maintenance manuals presented in Appendices "A" and "B". These modifications will be incorporated into the final operator's and maintenance manuals once the production version of the lift system is placed into service. The following are the modifications to the original design as conducted by Prévost Car Inc.

3.1.1 Single Door Operation

The original design of the parallelogram door linkage and bottom door hinge was not successful for several reasons, the major one being the difficulty of designing adequate seals while permitting both opening modes. In addition to water leakage problems, the bottom latch was collecting dust and mud and became inoperable. The cleaning procedure was also very difficult. Therefore, the door was modified and now uses a piano type hinge providing an easy sealing band and an adequate structural connection.

Thus, the lower door is hinged at its lower edge and opens down, providing a loading ramp for the wheelchair and permitting access to luggage on other occasions.

3.1.2 Air Over Hydraulic Door Actuator

A modification to the door actuator control was required to make it more practical to operate. The original pneumatic system was producing an erratic movement of the door which was difficult for an inexperienced operator to control and could have caused serious injuries. When initiating the opening motion of the door, the air pressure would build up in the cylinders until the door started to open. As the door fell down on its own weight, it was accelerated by the pressurized cylinders.

Similar pneumatic power is used on the modified door control but now uses air pressure over hydraulic fluid (see Figure 6). The new hydraulic cylinders uses non-compressible fluid with small diameter piping to allow smooth and progressive motions of the door. The positive power is used in the closing mode while the opening mode is accomplished by the door pivoting down on its weight while fluid drains through a precalibrated orifice.

3.1.3 Park Brake Interlock with Lift Door Open

Because the door ramp position is used for access to the luggage compartment as well as for wheelchair lift use, it was found appropriate to add an interlock system that keeps the parking brake "on" until the lift door is closed. Since the lift does not operate while the door is open, the probability of the driver moving the vehicle with an open door is very low when boarding a disabled person. However, the same situation does not exist after loading luggage. Under such circumstances, the door could be a serious safety hazard with the possibility of creating serious injuries to nearby persons or damage to the vehicle. The door open park interlock was an obvious means to avoid such undesirable hazards.

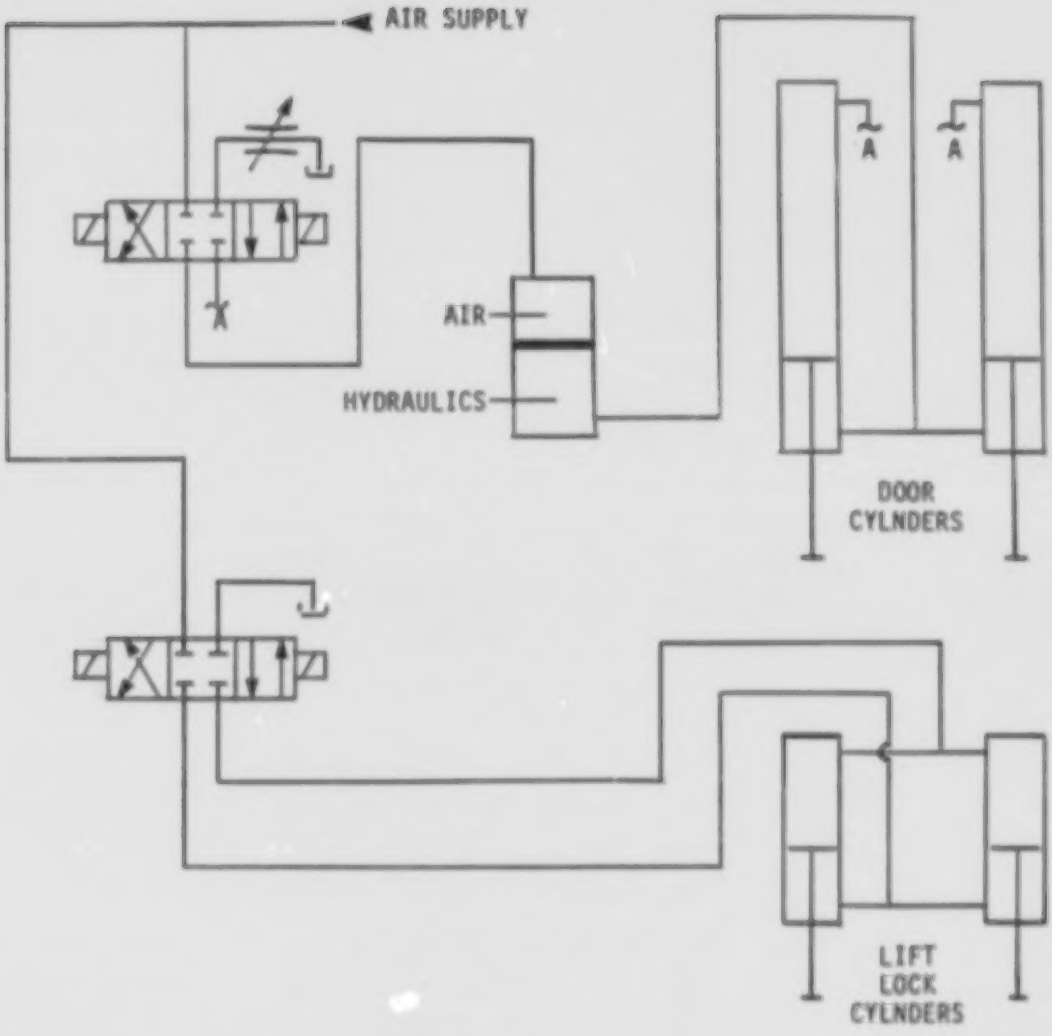

FIGURE 6
Modified Pneumatic System Schematic

4.0 CONCLUSIONS

The internal elevator type wheelchair lift has many inherent design benefits when compared to an external lift:

- the user is protected from inclement weather,
- the lift platform is one of the wheelchair locations,
- seat loss is minimized,
- the lift integrates well with existing interior and exterior aesthetics, and
- the user perceives the lift as safe, comfortable, dignified and part of the normal bus operation.

The wheelchair lift system installed in the Prévost coach has a number of additional design benefits:

- the lift is located in a low stress area which results in simpler structural modifications,
- the "kneeling" suspension option allows the use of a fixed floor below the lift,
- the fixed floor results in greater structural integrity and ensures that the baggage area can be sealed to the same extent as the other baggage areas,
- the lift is located adjacent to the front door which is not only convenient for the driver but is perceived by users as the proper location,
- the lift mechanisms and controls are simple, reliable and use existing industry technology, which is easily understood by both drivers and maintenance personnel,
- the unique door system allows the "clam shell" doors to be used as a ramp/roof in one mode of operation, or the lower door to be used strictly as a regular baggage door in the other mode,
- the "zero seat loss" system of sliding and folding seats is so effective that the interior of the bus is virtually identical to a regular bus, and
- the method of platform lifting and lowering using four vertical chain runs has a minimal space requirement with little lost baggage space and only a minor protrusion into the passenger compartment.

The overall project objective was to allow Prévost Car Inc. to acquire the technology to produce an intercity coach with a wheelchair lift within its production facility in Sainte-Claire, Québec. With the development of the third generation lift system, this project objective was successfully accomplished.

After the prototype was completed, some design changes were required to the door system to allow better operation of the doors. With these modifications the technical aspects of the design have been proven successful during subsequent demonstrations.

APPENDIX "A"
Operator's Manual

PREVOST MIRAGE
WHEELCHAIR LIFT
OPERATORS MANUAL

May 1988

Prepared For

PREVOST CAR INC.

By

T E S Limited

Ottawa, Canada

T E S Report Number: C794-1

A3

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INTRODUCTION

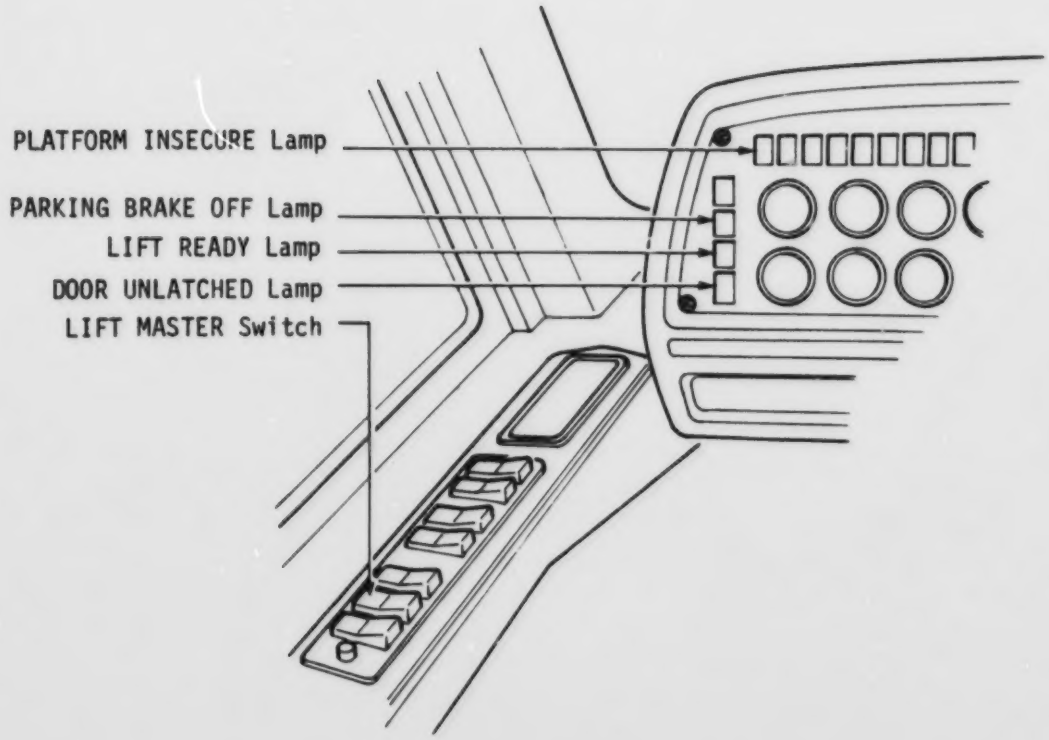
A hydraulically operated wheelchair lift has been installed in this Prevost Mirage coach. Accommodations are provided for two wheelchairs in the coach. In the event that no wheelchairs are transported, folding and sliding seats can be deployed to reduce the seat loss for wheelchair space to zero.

This manual outlines the general operating procedures to be followed for the various modes of operation of the lift to ensure safe and reliable service.

This manual is intended only for coach operators who will be directly involved in the use of this specially equipped coach.

NORMAL LIFT OPERATION

This Prevost Mirage coach is equipped with a hydraulically operated wheelchair lift. Switches at the drivers area and lift area control the operation of the lift. Telltale lamps at the dash inform the operator of any malfunctions.



CONTROLS AT DRIVER'S AREA

The exterior door can be operated as a conventional baggage door or a ramp for the wheelchair lift.

Loading a Wheelchair Passenger

To load a wheelchair passenger on the bus, the driver should employ the following operation sequence. See the illustration at the end of the section for the location of the controls.

1. Shift the transmission to neutral, engage the parking brake and turn on the fast idle and hazard flasher switches. Place the LIFT MASTER switch in the ON position.

2. At the lift area, fold the seat cushions of the seats on and behind the lift platform upwards. On the seat on the lift platform, release the seat release levers by rotating the levers counterclockwise. Push the seat rearward off the platform as far as possible. Engage the pedestal locks by pushing down on the levers and rotating clockwise. Extend the lower barricade belt by pulling the belt out from the lower rear aisle side of the seat in front of the lift and latching into the receptacle in the base of the first seat behind the lift. Extend the upper barricade belt by pulling the belt out from the upper rear aisle side of the seat in front of the lift and latching into the side of the second seat behind the lift.

3. Ensure that there is no baggage in the compartment below the lift. Lower the lift by pressing the PLATFORM switch. The locks will automatically retract and platform movement will automatically stop at the lower level.

4. Exit the bus and release the ramp by pulling down on the small latch located on the baggage door latch. Stand ahead of the door and ensure that no persons or objects are within five feet of the side of the coach in the area of the door. Insert the key in the keyswitch and lower the ramp by turning the key in the direction indicated. Open the upper door by pulling the lower edge away from the coach. The door will open fully without further assistance.

5. Assist the wheelchair user onto the platform. The wheelchair should be facing forward on the platform. Engage the brakes on the wheelchair. (PHOTOGRAPH 1)

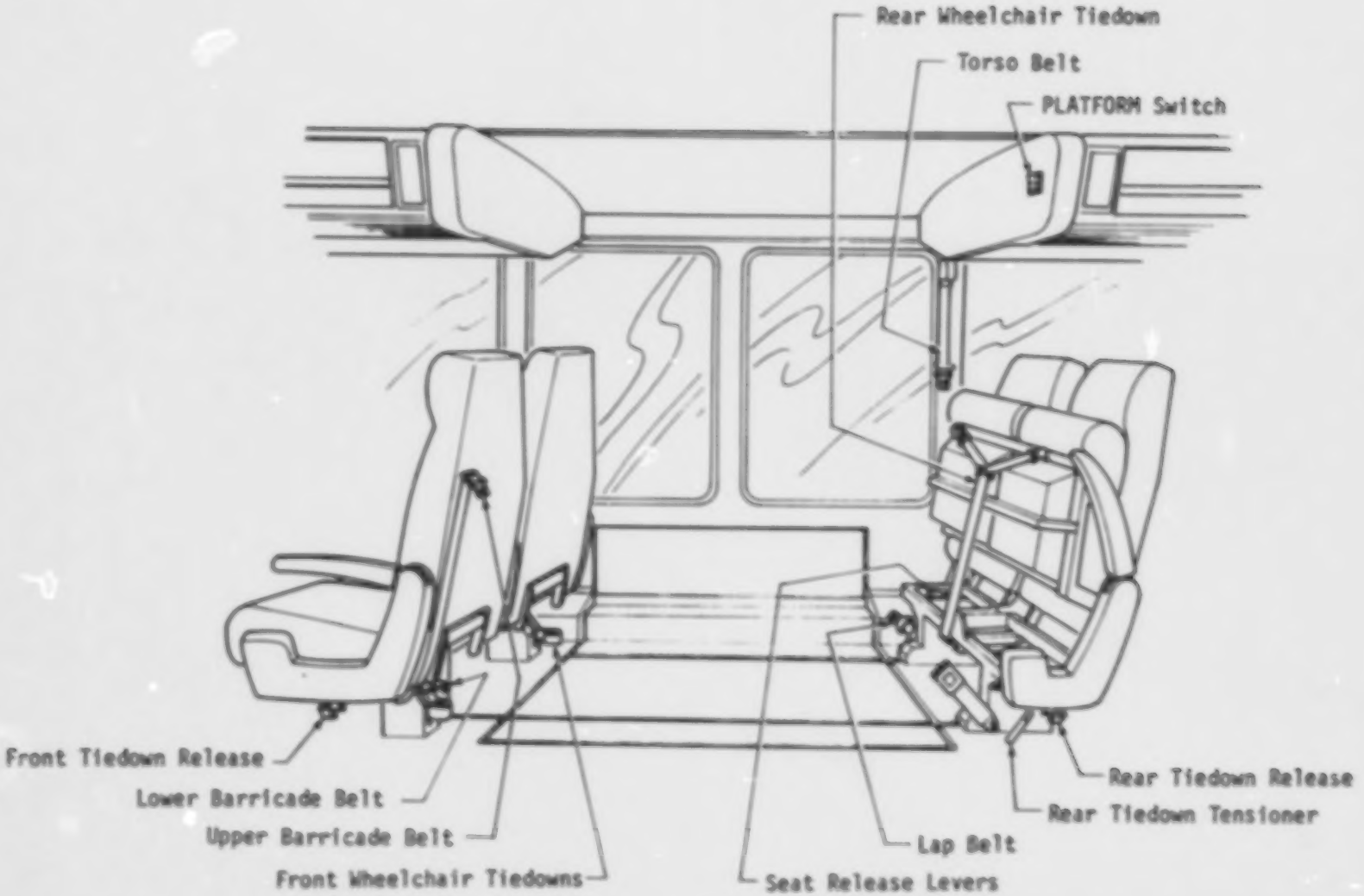
6. Pull the upper door closed. Insert the key in the keyswitch and turn the key in the direction indicated to raise the ramp. Latch the ramp by pushing on the upper edge of the ramp. (PHOTOGRAPH 2)

7. Raise the platform using the PLATFORM switch. The platform will automatically stop at floor level and the locks will automatically extend. (PHOTOGRAPH 3)

8. Unlatch and retract the upper and lower barricade belts and release the wheel brakes on the wheelchair. Push the wheelchair rearward against the folded seat. Pull out the front tiedown release knob, extend the front wheelchair tiedowns and hook the tiedowns around the front of the wheelchair. Push the wheelchair forward, pull out the rear tiedown release knob, and hook the rear wheelchair tiedowns to the rear frame of the wheelchair.

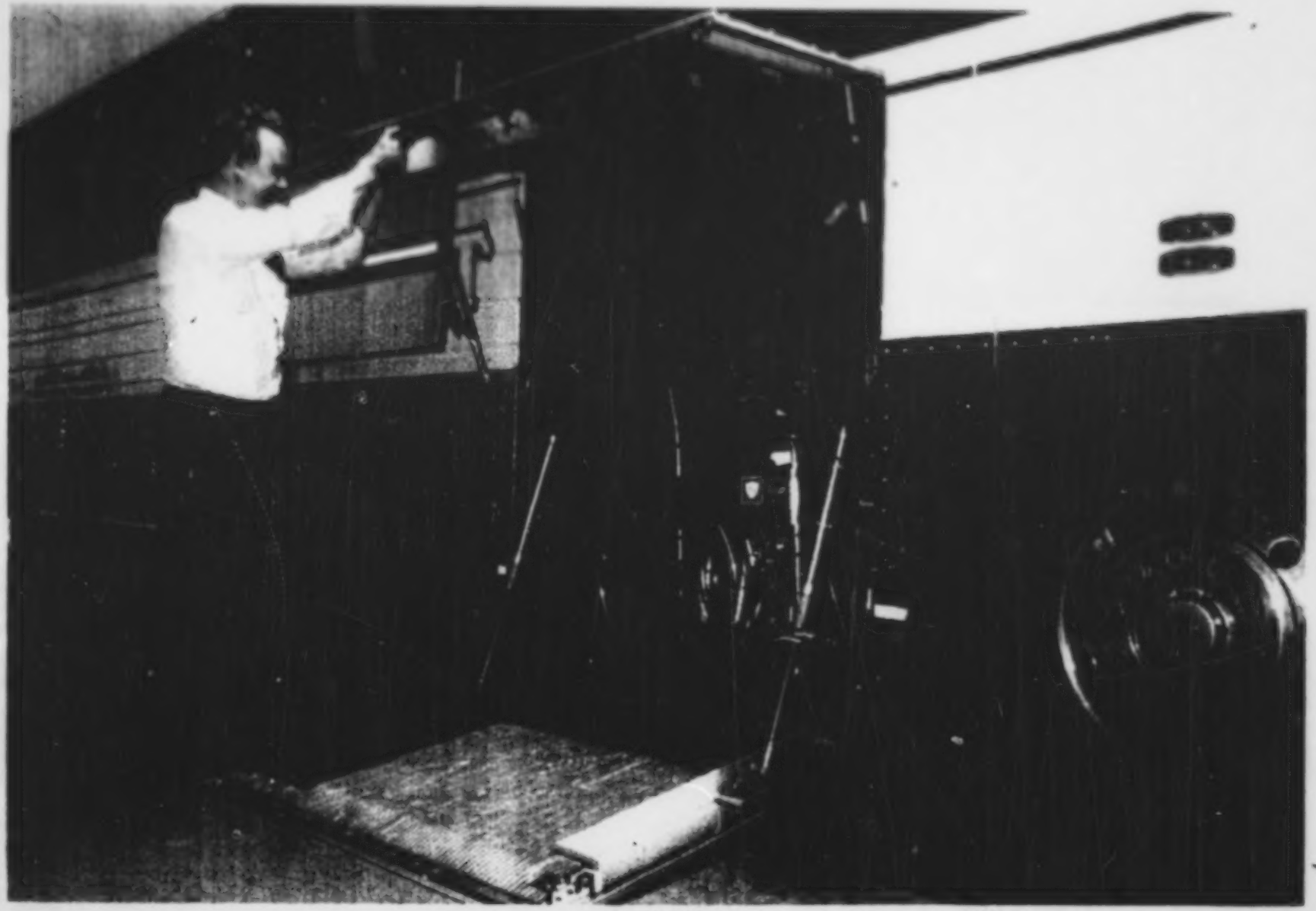
9. Push the wheelchair rearward, leaving about a handswidth clearance between the wheelchair and the seat frame. Push in both the front and rear tiedown release knobs and tension the belts by pushing in and rotating the rear tiedown tensioner handle.

10. Unreel the lap belt, pass the belt under the wheelchair armrests and latch the belt into the buckle. Unreel the torso belt, place in over the wheelchair occupant's shoulder and under the wheelchair armrest. Latch the belt onto the lap belt buckle. (PHOTOGRAPH 4)



CONTROLS AT LIFT

PHOTOGRAPH 1
LOADING A WHEELCHAIR PASSENGER



PHOTOGRAPH 2
OPENING/CLOSING UPPER DOOR

PHOTOGRAPH 3

RAISING LIFT PLATFORM

PHOTOGRAPH 4

SECURING LAP AND TORSO BELTS

Unloading a Wheelchair Passenger

To unload a wheelchair passenger, the driver should employ the following sequence.

1. Shift the transmission to neutral, engage the parking brake and turn on the fast idle and hazard flasher switches. Place the LIFT MASTER switch in the on position.

2. Release the wheelchair tiedown belts by pulling out the front and rear tiedown release knobs, and remove and retract the tiedown belts.

3. Extend the lower barricade belt by pulling the belt out from the lower rear aisle side of the seat in front of the lift and latching into the receptacle in the base of the first seat behind the lift. Extend the upper barricade belt by pulling the belt out from the upper area aisle side of the seat in front of the lift and latching into the side of the second seat behind the lift.

4. Ensure that there is no baggage in the compartment below the lift. Lower the lift by pressing the PLATFORM switch. The locks will automatically retract and platform movement will automatically stop at the lower level.

5. Exit the bus and release the ramp by pulling down on the small latch located on the baggage door latch. Stand ahead of the door and ensure that no persons or objects are within five feet of the side of the coach in the area of the door. Insert the key in the keyswitch and lower the ramp by turning the key in the direction indicated. Open the upper door by pulling the lower edge away from the coach. The door will open fully without further assistance.

6. Assist the wheelchair user off the platform.

7. Pull the upper door closed. Insert the key in the keyswitch and turn

the key in the direction indicated to raise the ramp. Latch the ramp by pushing on the upper edge of the ramp.

8. Raise the platform using the PLATFORM switch. The platform will automatically stop at floor level and the locks will automatically extend.

9. At the lift area, release and retract the upper and lower barricade belts. Release the seat release levers by rotating the levers counterclockwise. Pull the seat forward onto the platform as far as possible. Engage the pedestal locks by pushing down on the levers and rotating clockwise. Lower the seat cushions and armrests.

EMERGENCY LIFT OPERATION

The following sequence should be followed if the lift fails to operate using the normal operating sequence (refer to Photograph 5).

Lowering the Lift

1. Stop the bus, shift the transmission into neutral, engage the parking brake and turn on the four way flashers.

2. Open the baggage door on the compartment beside the lift, and lower the aluminum cover underneath the main floor by releasing the latches on the sides of the cover.

3. Remove the pump handle from the clips inside the cover and attach to the pump. Remove the directional valve handle from inside the cover and attach to the directional valve.

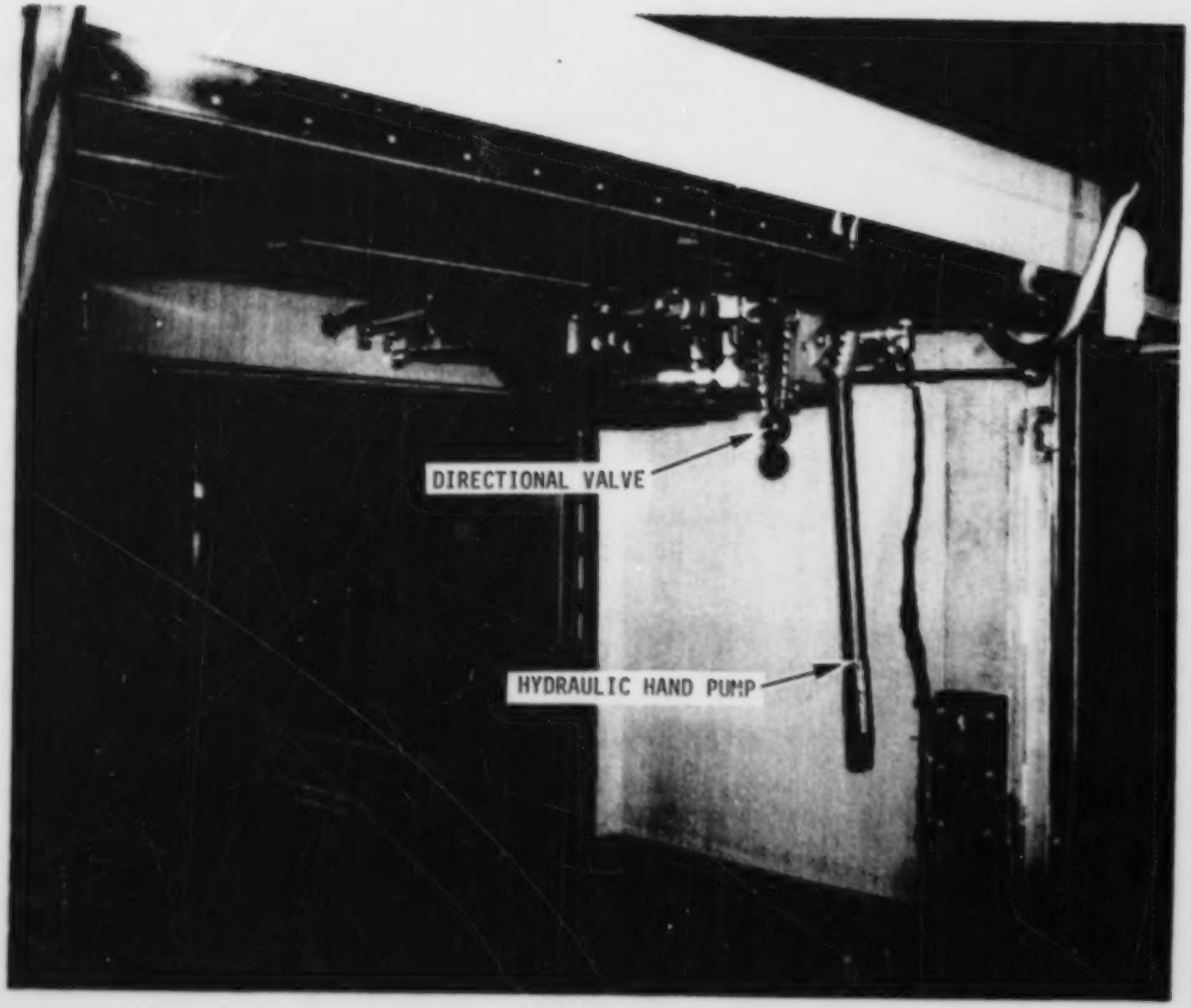
4. Retract the platform locks by pressing the manual override button on the air valve.

5. Push the directional valve handle towards the centre of the bus while cycling the pump handle until the lift is lowered.

Raising the Lift

1. Pull the directional valve handle away from the bus while cycling the pump handle until the lift is raised.

2. Extend the platform locks by pressing the manual override button on the air valve.



PHOTOGRAPH 5

LIFT EMERGENCY CONTROLS

APPENDIX "B"
Operator's Manual

PREVOST MIRAGE
WHEELCHAIR LIFT
MAINTENANCE MANUAL

May 1988

Prepared For

PREVOST CAR INC.

By

T E S Limited

Ottawa, Canada

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1.0 INTRODUCTION

The following manual describes the wheelchair lift as installed in this Prevost Mirage XL coach. All lift components and systems are described and repair procedures are detailed. As well, a preventative maintenance schedule is presented.

The instructions in this manual do not supersede proper workshop and safety practices, which should be employed at all times.

2.0 STRUCTURAL REINFORCEMENTS

The installation of the wheelchair lift requires additional structural reinforcements around the lift opening. Many of these reinforcements serve a dual purpose as guides for the lift mechanism as well as structural members.

All additional components are standard structural steel sections. Should any repair of the modified sections become necessary, methods similar to those used on the unmodified bus structure may be employed. Prevost Car should be contacted before any such work is attempted in order to advise of any welding and finishing procedures that should be followed to retain the original strength of the structure and any clearances and dimensions that should be maintained to ensure that the lift functions correctly.

3.0 LIFT MECHANISM

The lift mechanism consists of the guide channels, drive mechanism and lift platform.

Guide channels are located at the four corners of the lift opening and each contain a continuous run of roller chain. Lugs from the lift platform extend into these channels and attach to the chains. The platform is limited in fore-aft and lateral movement by contact between the lugs and the guide channels.

The roller chains run over sprockets at the top and bottom of the guide channels. The upper sprocket acts as an idler and the lower sprockets are driven by transverse drive shafts in front and behind the lift well. A centrally located hydraulic motor drives through a reduction gear box, a splitter gearbox, and intermediate chain drives to the drive shafts. Each run of roller chain is tensioned by a manually adjusted tensioner mechanism. Synchronizer hubs are employed on the drive shafts to adjust the relative position of the drive chains.

The lift platform is a steel weldment covered by a plywood floor. Rubber seals around the edges of the platform prevent drafts in the raised position. The lugs attaching the drive chains to the platform are bolted into recesses in the platform.

A view of the drive arrangement is shown in Figure 1.

3.1 Removing and Replacing Lift Platform

1. With the lift platform in mid travel, unbolt the drive chain lugs where they attach to the lift platform.

2. Disconnect the drive chain between the splitter gearbox and the front driveshaft by removing the master link.

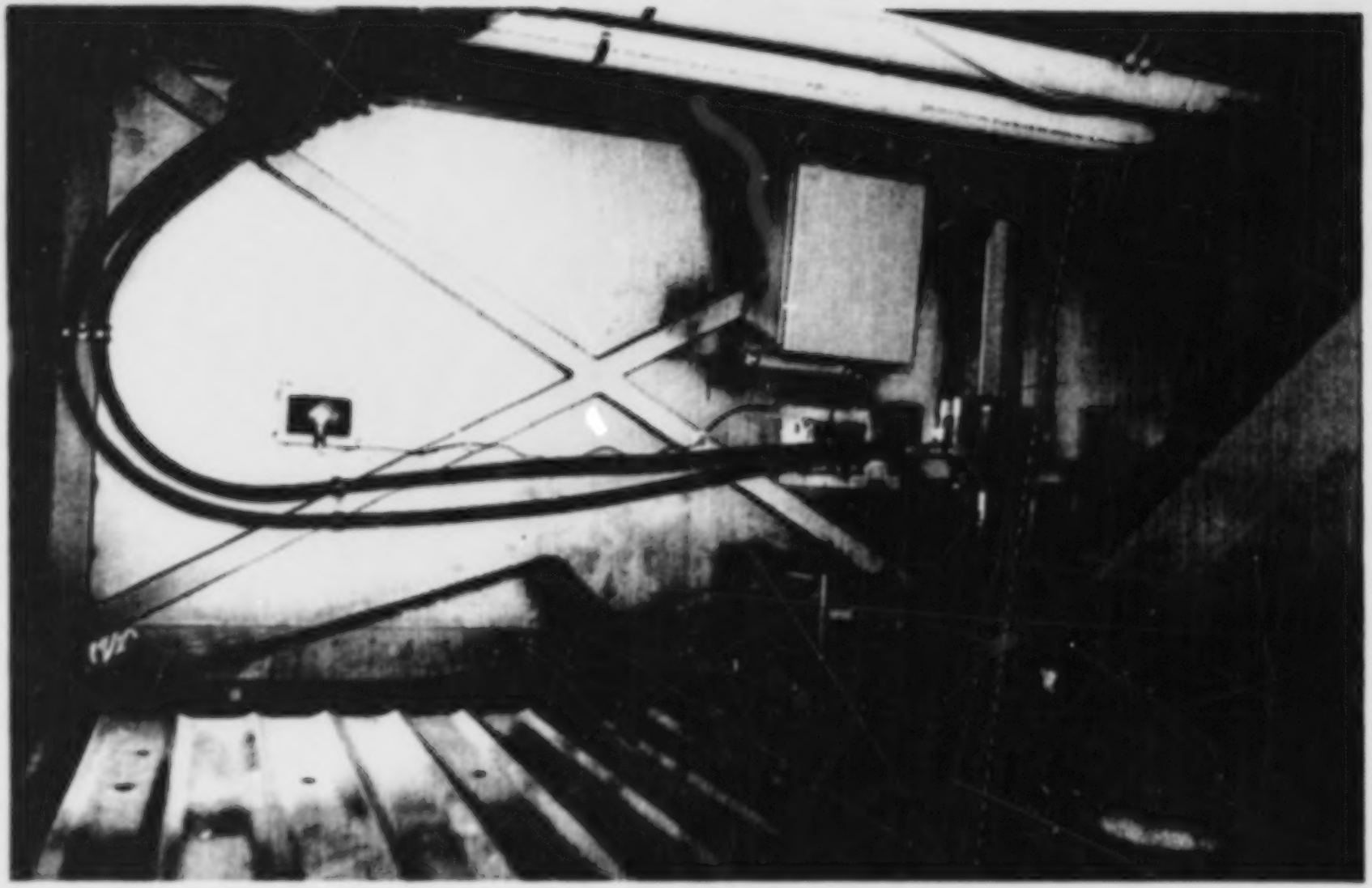

FIGURE 1

LIFT DRIVE ARRANGEMENT

3. Lift the front of the platform until the lugs are disengaged from the platform and remove the platform. If necessary, remove well skins from around the lugs to allow clearance for removal.

4. Replacement of the platform is the reverse procedure of the above. The platform should be raised and the height of each corner adjusted if necessary so the platform is flush with the main floor following installation.

3.2 Adjusting Height of Platform

1. Raise the lift platform fully.

2. Underneath the lift, remove the sheet metal screws securing the covers over the drive shafts.

3. Loosen the bolts clamping the synchronizer hub halves together and rotate the driveshaft sections until the platform is level with the surrounding floor.

4. Tighten the synchronizer hub bolts and replace the covers underneath the lift, resealing where necessary.

3.3 Adjusting Chain Tensions

1. There are six chain drive tensions to be adjusted using one tensioner for the intermediate drives to the drive shafts and one tensioner per chain at each corner of the lift. In addition, one intermediate drive is adjusted by moving the drive base. Refer to Figures 2 and 3 for illustrations of the intermediate and platform tensioners.

2. The intermediate drive tensions are adjustable by removing the aluminum panel from inside the front left baggage compartment. The chain drive without a tensioner should be adjusted by sliding the drive base until the chain deflects approximately 3/8" - 1/2" (10 - 12

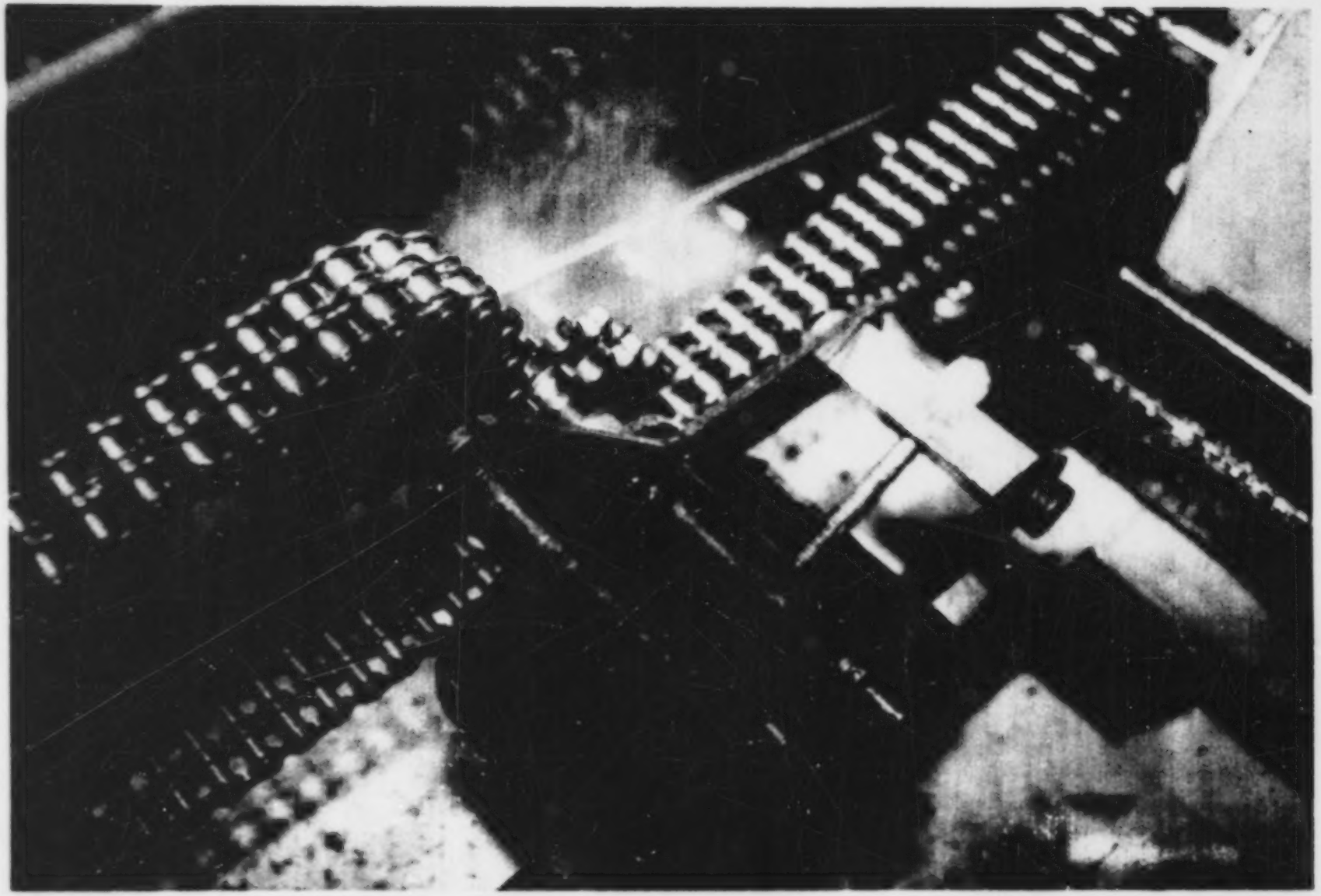

FIGURE 2
INTERMEDIATE DRIVE TENSIONER

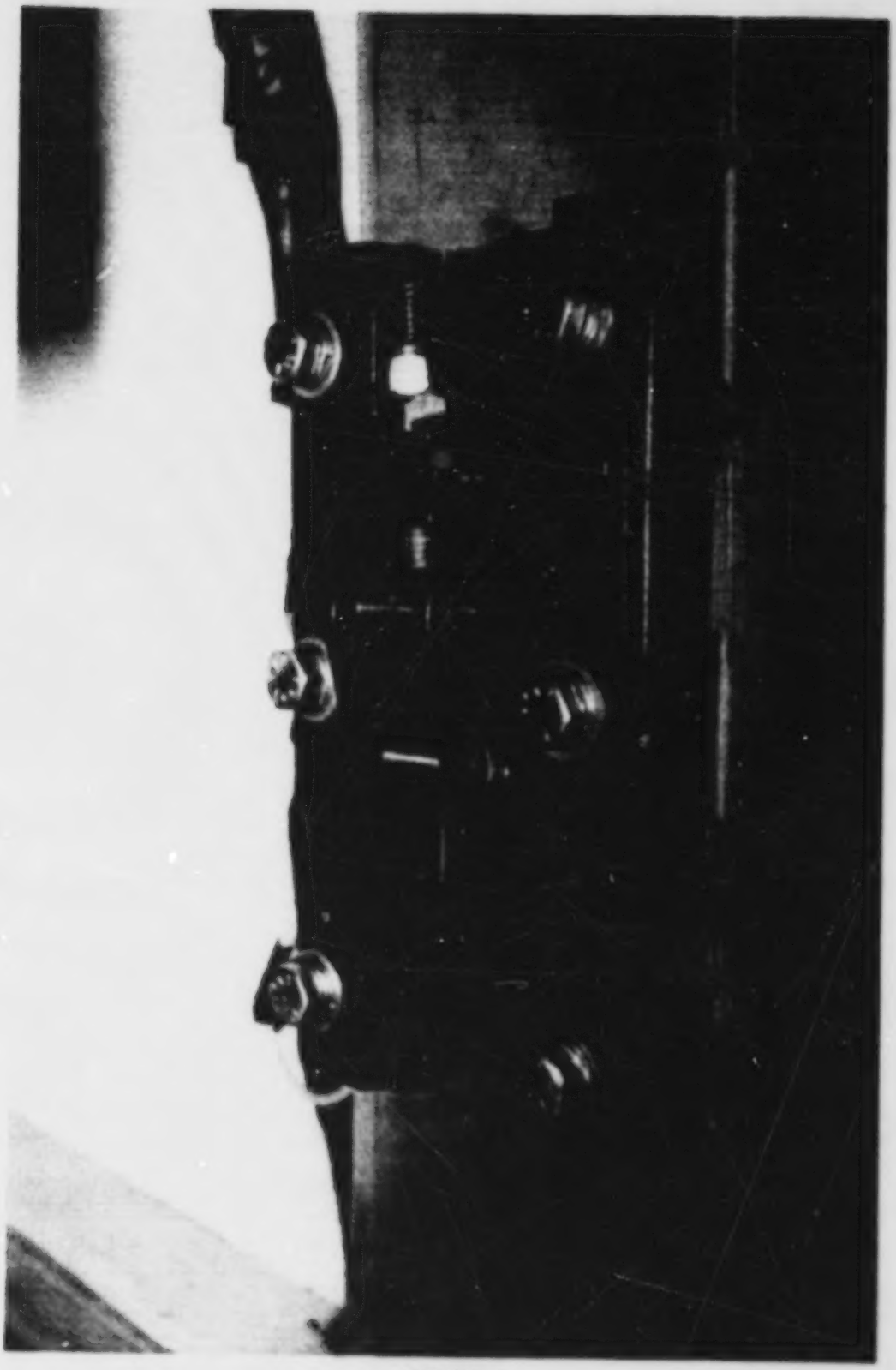

FIGURE 3

PLATFORM CHAIN TENSIONER

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mm). The tensioner for the other drive chain should then be adjusted to deflect approximately 1/2" - 3/4" (12 - 20 mm) in mid-span.

3. The rear platform chain tensioners are accessible through the baggage compartment behind the lift. The chain should be adjusted to deflect approximately 3/8" - 1/2" (10 - 12 mm) in mid-span.

4. The front outer platform chain tensioner is accessible through the removeable cover on the front lift well skin. The chain should be adjusted to deflect approximately 3/8" - 1/2" (10 - 12 mm) in mid-span.

5. The front inner platform chain tensioner is accessible through the right front wheel well by removing the sheet metal cover. The chain should be adjusted to deflect approximately 3/8" - 1/2" (10 - 12 mm) in mid-span.

6. If sufficient travel is not available at any tensioner to achieve the required deflection, locate the master chain link, and with a chain disassembly tool, remove one chain link.

4.0 HYDRAULIC SYSTEM

An engine mounted pump is used to supply fluid to the lift system through a relief valve and a directional valve. The directional valve is located in the engine compartment and controls the direction of rotation of the hydraulic pump. The relief valve, also located in the engine compartment is adjusted to permit only the rated load to be lifted so as not to overstress any components of the lift system.

A manually operated hand pump and directional control valve are provided to operate the lift in the event of malfunction or failure of the primary hydraulic system. These components are mounted on the underside of the main floor in the baggage compartment behind the lift.

4.1 Checking Hydraulic Fluid Level

1. Open the rear engine doors. The reservoir is located on the hydraulic pump at the right rear of the engine (see Figure 4).

2. Remove the reservoir cover and observe the fluid level. The level should be within 1 inch (25 mm) of the top of the reservoir. Replenish as necessary with automatic transmission fluid (ATF).

4.2 Adjusting Relief Valve

1. Open the rear engine doors. The relief valve is mounted underneath the directional valve on the right hand engine mounting frame.

2. Place a 600 lb (275 kg) load on the lift platform and adjust the relief valve by loosening the lock nut and turning the screw until the valve is relieving at this load when the platform is being raised. Tighten the locknut and recheck the aujustment.

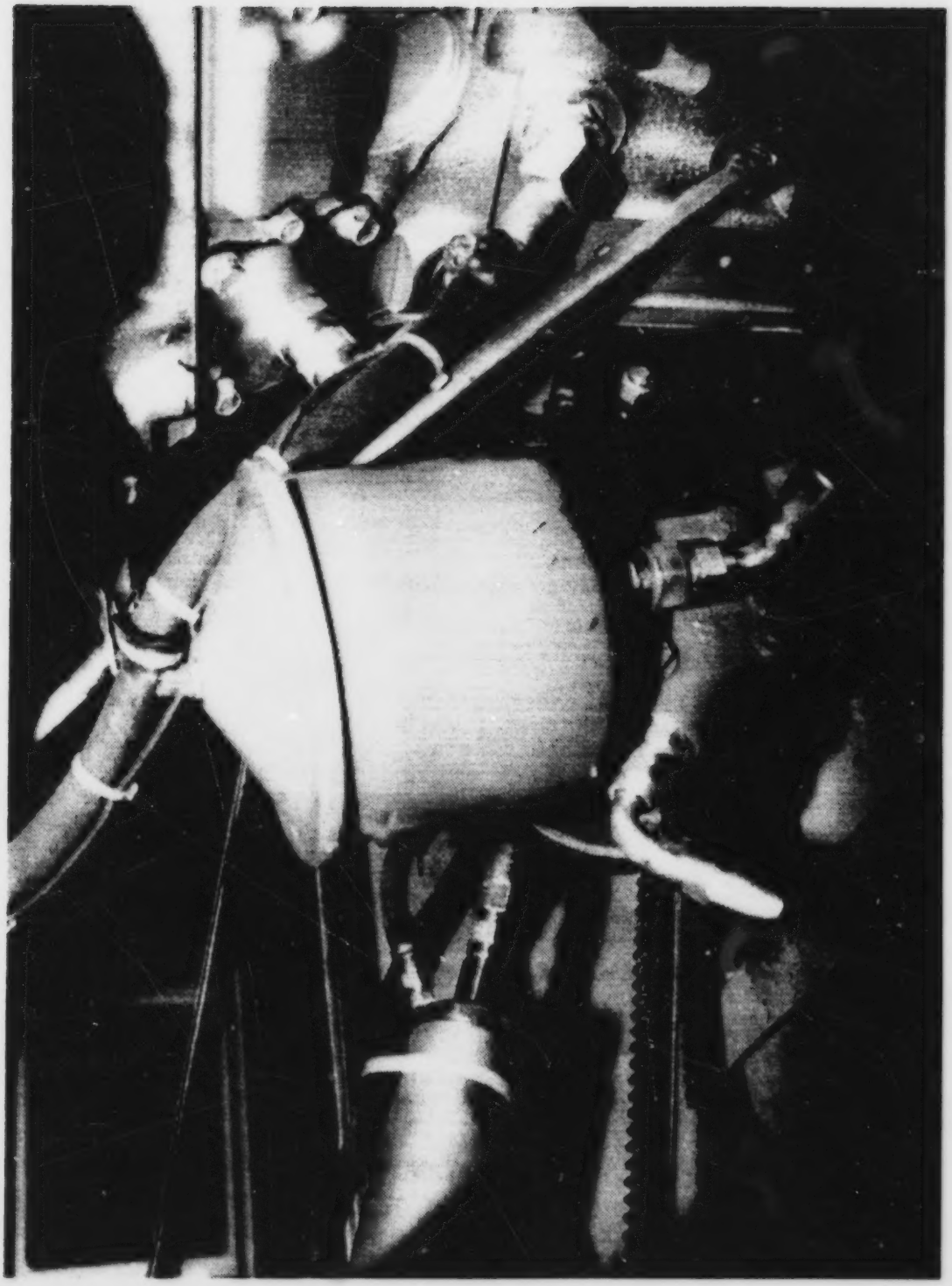

FIGURE 4
HYDRAULIC PUMP AND RESERVOIR

5.0 AIR SYSTEM

Air pressure is taken from the auxiliary air tank in the front spare tire compartment and routed to directional valves for the platform locks and doors mounted in the baggage compartment behind the lift.

The platform lock and door operating air cylinders are connected in parallel to their respective control valves. Flow control valves are installed on the exhaust ports of the control valves so that the cylinder speed can be adjusted.

6.0 PLATFORM LOCKS

The lift platform is held in place in the upper position with two wedge locks, one at the front, and one at the rear of the platform.

The locks extend through the well skin and into recesses in the underside of the platform and are driven by double acting air cylinders through toggle linkages. The linkages prevent the movement of the locks in the event of loss of air pressure.

The rear locks and air valves are covered by a protective aluminum tray that hinges downward for servicing. The front locks are accessible through a removeable panel in the front well skin.

6.1 Adjusting Platform Locks

1. The platform locks should be adjusted so that, when retracted, the locks do not extend beyond the well skin and, when extended, the locks contact the platform but do not raise the platform by more than 1/16" (2 mm). This will prevent overstressing the chain links.

2. The position of the locks can be adjusted using the threaded yoke on the air cylinder and by bending the linkage travel stops welded to the structure.

7.0 DOORS

The doors consist of upper and lower sections, hinged above and below the lift opening. The lower door can be operated as a conventional baggage door, using a handle of similar appearance and operation to the other baggage door handles, or as a ramp for the wheelchair lift, using a smaller handle inset into the baggage door handle.

The lower door has latches at the upper corners and combination latch/hinges at the lower corners. When the door is lowered as a ramp, only the upper latches are released and air cylinders raise and lower the door. When raised as a baggage door, the door is guided by a parallelogram linkage and assisted with a pan of gas filled struts. The air cylinders form a part of this linkage, and when the door is opened, the cylinders are pressurized to prevent unwanted cylinder extension.

The upper door is held in the closed position by an overhang on the lower door, and is opened manually, assisted by gas filled struts.

Screwed on access panels on the inside face of the lower door permit access to the latching mechanisms for servicing.

8.0 RESTRAINTS AND SEATS

8.1 Folding and Sliding Seats

Folding and sliding seats are fitted on each side of the coach behind the designated wheelchair positions. These seats slide on tracks recessed into the floor and are locked at either end of their travel with pins that engage latches underneath the tracks.

The seats are constructed using Prevost seat back and base cushions with specially designed base frames and pedestals. The pedestals enclose the locking mechanisms and rollers that ride on the tracks. The base cushions are attached to a separate frame that allows the cushions and frame to be folded upwards to create clearance for the wheelchair.

8.2 Folding Seats

Folding seats are fitted behind the folding and sliding seats and are similar to these seats except that standard seat pedestals are employed in place of the sliding and locking pedestals.

8.3 Restraints

The restraints fitted to this coach comprise front and rear wheelchair tiedowns, and lap and torso belts for the wheelchair occupant.

The wheelchair tiedown belts extend from automatic retractors, modified to permit manual locking of the retraction mechanism. The rear tiedown belt retractor also incorporates a manually operated tensioning mechanism.

The lap and torso belts attach to the folding and sliding seat frame and window frame with high strength bolts.

The webbing on any restraint belt should be replaced if it is stretched as would occur during an accident.

9.0 CONTROL SYSTEM

The lift is conntrolled by a series of switches and interlocks, which permit the operation of the lift safely.

Inputs to the system consist of manually operated lift master, lift platform and ddoor operating switches and microswitches sensing the position of the lift platform, platform locks and door. Outputs are sent to the telltale lamps on the dash and to the lift platform, platform locks and door operating solenoids.

Figures 5 and 6 shows the lift control schematic and identifies the individual compoonents and their location.

The following coonditions govern the system outputs and should be used as a guide for troubleshooting.

INPUT	OUTPUT	CONDITIONS
Lift master on (C1)	Lift circuits powered	Parking brake on (stud 69)
Lift control lower (C3)	Lock valve retract solenoid energized (V2)	Platform raised (S1) Door locked (S7) Locks not retracted (S5,S6)
	Lift valve lower (V1) solenoid energized	Platform not lowered (S2) Door locked (S7) Locks retracted (S5,S6) Locks not extended (S3,S4)
Lift control raise (C3)	Lift valve raise (V1) solenoid energized	Platform not raised (S1) Door locked (S7) Locks retracted (S5,S6) Locks not extended (S3,S4)

INPUT	OUTPUT	CONDITIONS
	Locks valve extend (V2) solenoid energized	Platform raised (S1) Door locked (S7) Locks not extended (S3,S4)
Ramp lower (C2)	Ramp valve lower (V3) solenoid energized	Door unlocked (S7) Platform lowered (S2)
Ramp raise (C2)	Ramp valve raise (V3) solenoid energized	Door unlocked (S7) Platform lowered (S2)
	Platform Not Secure (L4) lamp illuminates	Lift master switch on (C1) Pins not inserted (S3,S4)
	Power On lamp (L2) illuminates	Lift master switch on (C1) Parking brake on (stud 69)
	Door Unlocked lamp (L3) illuminates	Lift master switch on (C1) Door unlocked (S7)
	Parking Brake Not On (L1) lamp illuminates	Lift master switch on (C1) Parking brake not on (stud 69)
	Lift Well lamps (L5,L6) illuminate	Door unlocked (S7)

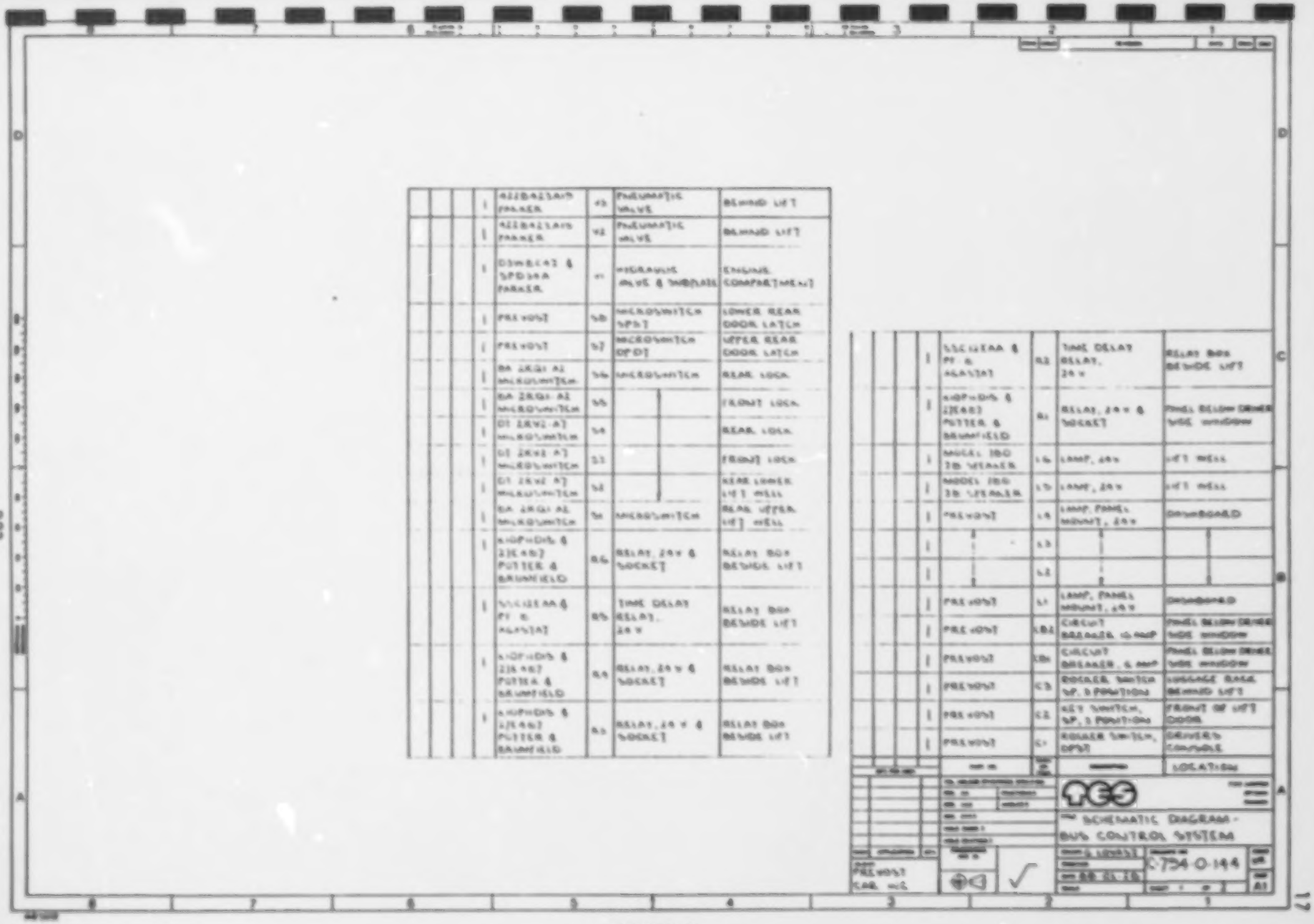

FIGURE 5

CONTROL SYSTEM SCHEMATIC - SHEET 1 OF 2

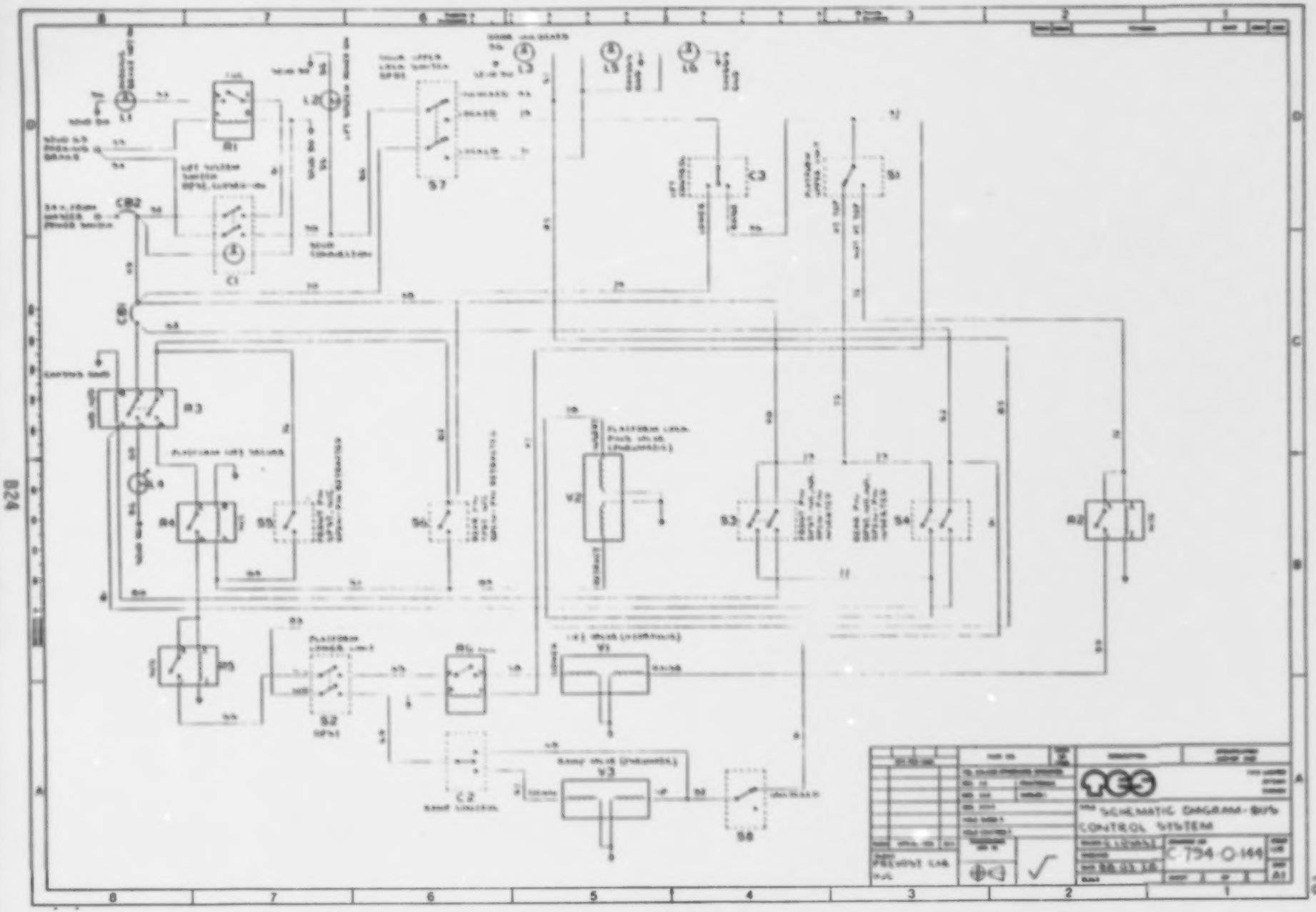

FIGURE 6

CONTROL SYSTEM SCHEMATIC - SHEET 2 OF 2

10.0 RECOMMENDED PREVENTATIVE MAINTENANCE SCHEDULE

The following items should be attended to in order to maintain the lift in a safe operating condition.

DAILY INSPECTION

1. Check hydraulic fluid level.

WEEKLY INSPECTION

1. Wash off road dirt from platform, ramp.
2. Check operation of sliding seats and clean tracks.

THREE MONTH INSPECTION AND SERVICE

1. Inspect door seals.
2. Inspect platform seals.
3. Inspect hydraulic hoses, lines, air lines.
4. Inspect restraint belts for fraying.
5. Check position of upper platform.
6. Check hydraulic hand pump by raising lift with hand pump.
7. Check and adjust tension of drive chains as required.
8. Inspect and lubricate drive chains.

APPENDIX "C"
List of Engineering Drawings

Dwg. No.	Description
C-794-0-1	Structure Assy, Modified - 5 sheets
C-794-0-2	Adapter - Pillow Block
C-794-0-3	Plate, Assy, Mtg, Pillow Block - Inboard Rear
C-794-0-4	Gusset - Inboard Rear
C-794-0-5	Plate Assy, Mounting, Pillow Block - Inboard Front
C-794-0-6	Plate Assy, Mtg, Pillow Block - Outboard Front
C-794-0-7	Brkt Assy, Mtg, Pillow Block - Inboard Lower, Rear
C-794-0-8	Bracket Assy, Mtg, Pillow Block - Inboard Ctr, Rear
C-794-0-9	Brkt Assy, Mtg, Pillow Block - Outboard Lower Rear
C-794-0-10	Plate Assy, Mtg, Pillow Block - Outboard, Rear
C-794-0-11	Tube Assy, Support - Rear
C-794-0-12	Tube Assy, Support - Front
C-794-0-13	Support Assy, Pillow Block - Inboard Rear
C-794-0-14	Tie Plate
C-794-0-15	End Cap, Centre Duct - Rear
C-794-0-16	Side Cap, Centre Duct - Rear
C-794-0-17	Pivot Bracket, Platform Lock - Front & Rear
C-794-0-18	Pivot Shaft, Front & Rear
C-794-0-19	Gusset, Doorway
C-794-0-20	Guide Assy, Chain
C-794-0-21	Brkt Assy, Mtg, Pillow Block - Inboard Ctr, Front
C-794-0-22	Brkt Assy, Mtg, Pillow Block - Inboard Lower, Front
C-794-0-23	Instl of Restraint Points
C-794-0-24	Hydraulic/Pneumatic System Layout
C-794-0-26	Channel Assy, Centre Duct
C-794-0-27	Floor Pan, Lift Well
C-794-0-28	Guide Assy, Chain - Outbd Rear

Dwg. No.	Description
C-794-0-29	Frame Assy, Support - Hydraulic Motor
C-794-0-30	Support Assy - Gear Box
C-794-0-31	Wiring Harness Layout
C-794-0-32	Bracket Assy, Mtg, Pillow Block - Outboard Lower, Front
C-794-0-33	Gusset
C-794-0-34	Cover Assy, Drive Shaft - Front
C-794-0-35	Cover Assy, Drive Shaft - Rear
C-794-0-36	Skin, Lift Well - Front & Rear
C-794-0-37	Skin, Lift Well - Outboard
C-794-0-38	Skin, Side - Lift Well
C-794-0-39	Base Pan - Lift Well
C-794-0-40	Skid Pan - Lift Well, Inboard
C-794-0-41	Skid Pan - Lift Well, Outboard
C-794-0-42	Skin, Lift Well - Inboard
C-794-0-43	Housing, Light - Lift Well
C-794-0-44	Castings, Modified
C-794-0-45	Front Wheelchair Tie-Down Assy
C-794-0-46	Pedestal Assy
C-794-0-47	Belt Tensioner Assy
C-794-0-48	Seat Frame Assy - 2 sheets
C-794-0-49	Seat Base Assy
C-794-0-50	Chain Tensioner, Double Row - Subassemblies & Details
C-794-0-51	Chain Tensioner Assy - Double Row
C-794-0-52	Chain Tensioner, Single Row - Subassemblies & Details
C-794-0-53	Chain Tensioner Assy - Single Row
C-794-0-54	Sprocket Assy, Idler - Double Row
C-794-0-55	Drive Assy - Lift
C-794-0-56	Pillow Block Assy
C-794-0-57	Drive Shaft, Lift - & Details
C-794-0-58	Sprocket
C-794-0-59	Idler Shaft Assy
C-794-0-60	Shaft Assy, Inboard, Rear

Dwg. No.	Description
C-794-0-61	Shaft Assy, Centre, Rear
C-794-0-62	Shaft Assy, Outboard, Lower
C-794-0-63	Frame Assy, Platform & Details - 4 sheets
C-794-0-64	Platform Assy, Lift
C-794-0-65	Gen. Assy, Folding/Sliding Seat - 2 sheets
C-794-0-66	Cap, End
C-794-0-67	Collar Assy
C-794-0-68	Shim Plate, Pillow Block
C-794-0-69	Handle Belt Tensioner
C-794-0-70	Handle Assy, Seat Lock
C-794-0-71	Collar, Castellated
C-794-0-72	Buckle, Wheelchair Restraint
C-794-0-73	Yoke
C-794-0-74	Bracket, Internal Support, Retractor Box
C-794-0-77	Pedestal, Modified
C-794-0-79	Riser, Armrest Support
C-794-0-80	Adapter Bracket, Pedestal
C-794-0-81	Cross Tube Assy
C-794-0-82	Cover, Retractor Box
C-794-0-83	Retractor Box
C-794-0-84	Shaft Assy, Seat Lock
C-794-0-85	Pedestal Frame
C-794-0-86	Frame Assy, Pedestal, Aisle Side
C-794-0-87	Frame Assy, Pedestal, Wall Side
C-794-0-88	Bracket, Cable Release
C-794-0-89	Floor Channel
C-794-0-90	Ramp Plate
C-794-0-91	Pin, Platform Lock
C-794-0-92	Arm, Platform Lock
C-794-0-93	Pin Platform Lock Arms
C-794-0-94	Plate, Microswitch Mounting
C-794-0-95	Bracket, Lock Stop, Rear

Dwg. No.	Description
C-794-0-96	Bracket, Lock Stop, Front
C-794-0-97	Assembly, Platform Lock
C-794-0-98	Instl, Drive Shaft Cover & Skid Pan
C-794-0-99	Shaft Assy, Inboard, Front
C-794-0-100	Frame Assy, Lower Door/Ramp - 3 sheets
C-794-0-101	Backing Strip Assy - Door/Ramp
C-794-0-102	Upper Strip, Outer Skins
C-794-0-103	Lower Strip, Outer Skins
C-794-0-104	Door/Ramp Assembly - 3 sheets
C-794-0-105	Handle
C-794-0-106	Bracket, Shaft
C-794-0-107	Side Cover
C-794-0-108	Bracket Upper
C-794-0-109	Bracket Cable
C-794-0-110	Cable Anchor
C-794-0-111	Latch, Spring
C-794-0-112	Bracket, Idler Pulley, Upr.
C-794-0-113	Bracket, Idler Pulley, Lwr.
C-794-0-114	Slam Latch
C-794-0-115	Rotating Arm
C-794-0-116	Lower Latch
C-794-0-117	Lower Latch Bracket
C-794-0-118	Cable Anchor Shaft
C-794-0-119	Inner Skins - 3 sheets
C-794-0-120	Mod. Slam-Latch Ass.
C-794-0-121	Cable Anchor Assy
C-794-0-123	Cylinder Shaft Upper
C-794-0-124	Rotating Arm Bracket Assy
C-794-0-125	Cylinder Brkt Assy Upper
C-794-0-126	Latch Pin Brkt Assy
C-794-0-127	Door Ramp Seal
C-794-0-128	Lower Seal

Dwg. No.	Description
C-794-0-129	Backing Strip Upper Door
C-794-0-130	Outer Skin - Upper Door
C-794-0-131	Hinge Modified
C-794-0-132	Cylinder Brkt Assy (Lower)
C-794-0-133	Cylinder Brkt Assy (Upper)
C-794-0-134	Upper Door Seal
C-794-0-135	Inner Skin, Upper Door
C-794-0-136	Frame Upper Door Assy
C-794-0-137	Upper Door Assy
C-794-0-138	Cylinder Shaft Assy - Lower Door
C-794-0-139	Clevis Assy
C-794-0-140	Door Ramp Installation
C-794-0-141	Seal Installation
C-794-0-142	Interior Finishing Details - 2 sheets
C-794-0-143	Pivot Assy, Gas Spring
C-794-0-144	Schematic Diagram Bus Cont. Syst. - 2 sheets

APPENDIX "D"
Cycle Test Report

Prevost Wheelchair Lift

Cycling Test Report

C794 PREVOST BUS LIFT SYSTEM CYCLING TEST REPORT

1.0 INTRODUCTION

The cycling tests were divided into four separate tests:

1. Lift Mechanism (Automatic & Manual)
2. Wheelchair Restraint (Lift and Driver's Side)
3. Sliding Seat Mechanism (Lift and Driver's Side)
4. Barricade Belts

The following report details the cycling procedures, the number of test cycles and any observations that were noted during the testing.

2.0 LIFT MECHANISM TESTS

The procedure that was followed for the lift mechanism cycling test can be found in APPENDIX A. The lift cycling was combined with the Lift Side Seat Sliding Mechanism to check that the seats could slide fully from the lift platform to the bus floor.

An initial Lift Cycling test was aborted after a loose screw in the platform front locking pin mechanism disabled the limit switch and prevented the platform from moving.

Following the repair of the mechanism, the lift was cycled successfully 300 times using the automatic procedure to raise & lower the platform.

Observations

At 50 cycles
- seats were difficult to slide
- no oil leaks
- chains were tight

At 128 cycles
- solenoid valve (which directed the air pressure to either the rod end or the cylinder end of the pneumatic

cylinder) failed - thus preventing the locking pins from moving in & out

At 147 cycles
- front left lift chain had become very loose and required adjustment
- drive chains required tightening
- a bit of droop (1/8") developed between lift platform and edge of bus floor, but seat was sliding the same as before

At 170 cycles
- no change
- no oil leaks
- vertical rubber strips were coming unglued

At 220 cycles
- locking pins were extended before lift was raised (attributed to solenoid valve)
- lift was raised & lowered after locking pins were manually retracted
- test continued

At 270 cycles
- no oil leaks
- seats sliding more easily

At 312 cycles
- platform had not shifted its' position relative to the bus floor
- seats were sliding more easily than at beginning
- lift chains were loose - required tightening
- drive chains required adjustment (tightening)
- four of eight vertical rubber strips had come unglued
- rubber from vertical rubber strips was wearing - deposits were found at base of strips
- test completed

The solenoid valve required rebuilding so a test was done that cycled the locking pins mechanism only. The locking pins and the first three inches of platform travel were cycled 300 times and the following was observed:

at 150 cycles - no problems with locking pins.

at 300 cycles - vertical rubber strips required more regluing
- rubber was wearing from vertical rubber strips
- test completed

MANUAL CYCLING

The lift was manually cycled 5 times and no problems were observed.

3.0 WHEELCHAIR RESTRAINT TESTS

The procedure that was followed for the wheelchair restraint mechanism test can be found in APPENDIX A. Both the Lift Side and the Drivers Side restraint mechanisms were tested.

The Lift Side restraint mechanism was cycled 50 times.
The Drivers Side restraint mechanism was cycled 25 times.

Observations

Lift Side

At 32 cycles - rear release cable became stuck
- this was repaired and test resumed
- release cable jammed again and test was put on hold until release cable was repaired
- release cable was reinforced, casing was secured on all release cables Lift & Drivers Side

At 0 cycles - test resumed

At 34 cycles - no problems with release cables - release cables moving freely

At 50 cycles - test completed
- release cables were working well

Drivers Side

At 15 cycles - no problems

At 25 cycles - test completed

4.0 SLIDING SEAT MECHANISM

The procedure that was followed for the Sliding Seat Mechanism test can be found in APPENDIX A. The Lift Side sliding seat test was done in conjunction with the Lift Mechanism cycling tests. The Driver Side sliding seat test was done separately.

The Lift Side was cycled 100 times.
The Drivers Side was cycled 25 times.

Observations

Lift Side:

After 25 cycles - 1/4 turn lock was sticking
- this was readjusted and test was resumed
- seats required a lot of effort to move towards the rear

After 50 cycles - seats still moved with difficulty

After 75 cycles - seats moved more freely

After 100 cycles - test completed

Drivers Side:

After 25 cycles - test completed

5.0 BARRICADE BELTS

The procedure that was followed for the Barricade Belts tests can be found in APPENDIX A. These "Barricade Belts" consist of an upper belt and lower belt and are designed to alert personnel to the hazard created when the lift platform is lowered; and to prevent them from falling off the bus floor.

The Barricade belts were cycled 50 times.

Observations

After 50 cycles
- the barricade belts did not retract freely
- the lower barricade belt was slack and required some adjustment
- barricade belts remained anchored
- clasps remained anchored
- test completed

APPENDIX A

Test Procedures

1.0 LIFT MECHANISM TESTS

1.1 Prerequisites

Check "V" Complete

1.1.1 Obtain sandbags - 200 lbs.

1.1.2 Connect electric counter to upper limit switch and verify operation.

1.1.3 Ensure drive mechanism is integral.

1.1.4 Ensure box compartment is empty.

1.1.5 Ensure electrical system is intact.

1.1.6 Engage parking brake.

1.1.7 Turn lift switch on dashboard to "ON" position.

1.1.8 Ensure foot rests on seats are up.

1.1.9 Ensure seat bases are stationary and sliding seats are folded up.

1.1.10 Ensure tracks are free from any obstructions.

1.1.11 On the lift side, unlock the right and left 1/4 turn seat locks.

1.1.12 Slide the lift side seat back.

1.1.13 Lock the right & left 1/4 turn seat locks and check that the seat is secure.

1.1.14 Pull the lift barricade belts across and secure them.

1.1.15 Place sandbag on lift.

1.2 Lift Cycling

1.2.1 At lift control panel inside bus, engage toggle switch to lower platform.

1.2.2 After platform has been lowered, engage toggle switch to raise platform.

1.2.3 Repeat steps 1.2.1 to 1.2.2 for 300 cycles. Every 50 cycles inspect the following components and report any deficiencies.

	50 cycles	100 cycles	150 cycles	200 cycles	250 cycles	300 cycles
DRIVE MECHANISM (CHAIN ADJUSTMENT, LOOSE PARTS)						
PUMP (FLUID LEVEL, LEAKS)						
MOTOR (LEAKS COUPLING CONDITION)						
PLATFORM LOCKS (ADJUSTMENT)						

1.2.4 Test is complete after 300 cycles

1.2.5 Reverse steps 1.1.15 to 1.1.7 to return bus to pre test conditions.

1.2.6 Remove electric counter installed in Step 1.1.2.

2.0 WHEELCHAIR RESTRAINT TESTS

2.1 Lift Side Wheelchair Restraint Testing Prerequisites Check "V" Complete

2.1.1 Obtain a wheelchair & a dummy.

2.1.2 Engage the parking brake.

2.1.3 Turn the lift switch on the dashboard to the "ON" position.

2.1.4 Ensure that the foot rests on the seats are up.

2.1.5 Ensure that the seat bottom cushions on the stationary & sliding seats are folded up.

2.1.6 Ensure that the tracks are free from any obstructions.

2.1.7 On the lift side, unlock the right and left 1/4 turn seat locks.

2.1.8 Slide the lift side seat back to the mechanical stops.

2.1.9 Lock the right and left 1/4 turn seat locks and check that the seat is secure.

2.1.10 Connect the lap belt to the shoulder belt.

2.1.11 Pull the lift barricade belts across & secure them to the stationary seat.

2.1.12 At the lift control panel inside the bus, engage the toggle switch to lower the platform.

2.1.13 Put the wheelchair & the dummy on the platform.

2.1.14 At the lift control panel inside the bus, engage the toggle switch to raise the platform.

2.2 Lift Side Wheelchair Restraint Cycling

2.2.1 Position the wheelchair so that the back is against the frame stop pads.

2.2.2 Pull and turn the front release cable. This will unlock the retractor and allow the front restraint belts to move freely.

2.2.3 Pull the front restraint, wall side belt out and hook this to an appropriate place on the wall side of the wheelchair frame.

2.2.4 Pull the front restraint, aisle side belt out and hook this to an appropriate place on the aisle side of the wheelchair frame.

2.2.5 Position the wheelchair forward to allow for enough room to attach the rear harness belts.

2.2.6 Pull and turn the rear release cable. This will unlock the retractor lock and allow the rear harness belts to move freely.

2.2.7 Pull the rear harness belts out and hook them to an appropriate place on the rear of the wheelchair frame.

2.2.8 Position the wheelchair so that the back is against the frame stop pads and apply the wheel locks.

2.2.9 Push and turn the front release cable. This locks the retractor.

2.2.10 Push and turn the rear release cable. This locks the retractor.

2.2.11 Gently snug up the rear harness by pushing and rotating the tensioning handle clockwise. Care should be taken when tightening the rear harness to ensure that the wheelchair is not damaged.

2.2.12 Fasten the lap and shoulder belts.

2.2.13 Remove the lap and shoulder belts.

2.2.14 Gently push and rotate the tensioning handle clockwise one ratchet position (i.e. one "click"). This allows you to pull and turn the rear release

cable and thus unlock the retractor.

2.2.15 Pull and turn the front release cable. Remove and store front restraint hooks.

2.2.16 Remove and store rear harness hooks on storage studs.

2.2.17 The steps from 2.2.1 to 2.2.16 constitute one cycle. Repeat these steps for fifty cycles.

2.3 Driver Side Wheelchair Restraint Prerequisites

Check "V" Complete

2.3.1 Ensure that the wheelchair is on the lift side inside the bus.

2.3.2 Fold up the foot rests on the driver side sliding and stationary seats.

2.3.3 Fold up the bottom cushions on the stationary and sliding seats.

2.3.4 Ensure that the tracks are free from any obstructions.

2.3.5 On the driver's side, unlock the right and left 1/4 turn seat locks.

2.3.6 Slide the driver's side seat back to the mechanical stops.

2.3.7 Lock the right and left 1/4 turn seat locks and check that the seat is secure.

2.4 Driver Side Wheelchair Restraint Cycling

2.4.1 Position the wheelchair so that the back is against the frame stop pads.

2.4.2 Pull and turn the front release cable. This will unlock the retractor and allow the front restraint belts to move freely.

2.4.3 Pull the front restraint, wall side belt out and hook this to an appropriate place on the wall side of the wheelchair frame.

2.4.4 Pull the front restraint, aisle side belt out and hook this to an appropriate place on the aisle side of the wheelchair frame.

2.4.5 Position the wheelchair forward to allow for enough room to attach the rear harness belts.

2.4.6 Pull and turn the rear release cable. This will unlock the retractor lock and allow the rear harness belts to move freely.

2.4.7 Pull the rear harness belts out and hook them to an appropriate place on the rear of the wheelchair frame.

2.4.8 Position the wheelchair so that the back is against the frame stop pads and apply the wheel locks.

2.4.9 Push and turn the front release cable. This locks the retractor.

2.4.10 Push and turn the rear release cable. This locks the retractor.

2.4.11 Gently snug up the rear harness by pushing and rotating the tensioning handle counterclockwise. Care should be taken when tightening the rear harness to ensure that the wheelchair is not damaged.

2.4.12 Fasten the lap and shoulder belts.

2.4.13 Remove the lap and shoulder belts.

2.4.14 Gently push and rotate the tensioning handle clockwise one ratchet position (i.e. one "click"). This allows you to pull and turn the rear release cable and thus unlock the retractor.

2.4.15 Pull and turn the front release cable. Remove and store front restraint hooks.

2.4.16 Remove and store rear harness hooks on storage studs.

2.4.17 The steps from 2.4.1 to 2.4.16 constitute one cycle. Repeat these steps for twenty-five cycles.

3.0 SLIDING MECHANISM TESTS

3.1 Lift Side

Check "V" Complete

3.1.1 Lift foot rests on stationary and sliding seats.
3.1.2 Lift seatbases on stationary and sliding seats.
3.1.3 Ensure tracks are free from any obstruction.
3.1.4 Unlock the right and left 1/4 turn seat locks.
3.1.5 Slide the seat back.
3.1.6 Lock the right and left 1/4 turn seat locks.
3.1.7 Unlock the right and left 1/4 turn seat locks.
3.1.8 Slide the seat forward.
3.1.9 Lock the right and left 1/4 turn seat locks.
3.1.10 Lower seatbases on stationary and sliding seats.
3.1.11 Lower footrests on stationary and sliding seats.
3.1.12 Steps 3.1.1 to 3.1.11 constitute one cycle.
The test is complete after 100 cycles.

3.2 Drivers Side

Check "V" Complete

3.2.1 Lift foot rests on stationary and sliding seats.
3.2.2 Lift seatbases on stationary and sliding seats.
3.2.3 Ensure tracks are free from any obstruction.
3.2.4 Unlock the right and left 1/4 turn seat locks.
3.2.5 Slide the seat back.
3.2.6 Lock the right and left 1/4 turn seat locks.
3.2.7 Unlock the right and left 1/4 turn seat locks.
3.2.8 Slide the seat forward.
3.2.9 Lock the right and left 1/4 turn seat locks.
3.2.10 Lower seatbases on stationary & sliding seats.
3.2.11 Lower footrests on stationary & sliding seats.
3.2.12 Steps 3.2.1 to 3.2.11 constitute one cycle.
The test is complete after 25 cycles.

4.0 BARRICADE BELT CYCLING

Check "V" Complete

4.1 Ensure lift platform is raised.

4.2 Pull upper and lower barricade belts across and attach them to the stationary seat at the appropriate locations.

4.3 Apply a small force against the belts and check to see if the belts remain anchored.

4.4 Disconnect the belts from the seat and check to see that they fully retracts.

4.5 Repeat steps 4.2 to 4.4 for 50 cycles.